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BRIEFLY TOLD.

THE KANSAS CITY MUDDLE.—The gas situation at Kansas City, Mo., is in a decidedly muddled state just now—in fact, the muddle dates much further back than to-day; and the main trouble is that the atmosphere does not become clearer as time goes on. Quite the contrary, each week seemingly develops an added perplexity. The real contention began when the projectors of the Missouri Gas Company were ready to supply gas in competition with the old Kansas City Gas Company, and the successive steps in the contest were, cut rates—prices being put at figures that, certainly in the case of the old Company, which established the rate of 50 cents per 1,000 cubic feet, could not be productive of profit—the virtually free distribution of gas appliances, and bitter recrimination. The Missouri Gas Company fixed its selling price at $1 per 1,000 cubic feet, and then set out to attract and hold the favor of the consumers, who naturally were attracted strongly by the 50-cent figure of its competitor, by making the positive assertion that the opposition gas at the higher price was cheaper than the "regular" gas at the lower figure, for the reason that the former was more than twice as effective as the latter either in point of illuminating value or heating effect. Although the argument savors somewhat strongly of originality, it is nevertheless to our thinking an injudicious one, since it is so easy of proof or disproof; for in these days of advanced gas engineering it is a simple matter to determine authoritatively the relative values of gases as lighting and heating agents. Of course, it is not to be wondered at that Colonel Payne and his associates of the old Company were quick to challenge these utterances of their rivals, and a full statement of that which the former stand ready to accept in the shape of a trial or test of the respective gases will be found in our item columns for this week. One thing in their statement that has much of commonsense and vitality is the avowed belief that the gas consumers and the gas suppliers of Kansas City would each be better satisfied were the matters of testing and reporting upon the quality of the gas supplied, and the verification of complained of meters as well, put in the control of an official whose sayings upon such items would bear the seal of authority. If even this much good comes out of the gas war in Kansas City, the contest will not have been all in vain, although there has been and there still threatens to be by far too much of aggravated bitterness in this particular gas struggle, which could have been prevented by the exercise of a trifle of tact and a modicum of yielding at the time when the question of a new charter for the old Kansas City Gas Light and Coke Company was before the local authorities.

ORGANIZING THE ENGINEERING STAFF OF THE BROOKLYN UNION GAS COMPANY.—The proprietors of the Brooklyn Union Gas Company, through the executive management thereof, have at last gotten to the point where the permanent officering of the different bureaus of the Company is to be arranged. Naturally, the engineering bureau would be the first to be perfected and harmonized, and thus far these changes and appointments have been agreed upon. It gives us great pleasure to say that the management has named Col. Fred. S. Benson (whose excellent record for years as Engineer of the Nassau Company in its independent days is well known) to the position of Chief Engineer, and

his headquarters are to be in the main offices of the Company, No. 180 Remsen street. Colonel Benson will meanwhile have particular direction of the works of the Nassau branch. Mr. Thomas E. Byrne, also the holder of a bright record in connection with the engineering direction of the former Citizens Company, has been appointed Superintendent of Mains. His headquarters, too, will be in the main offices, 180 Remsen street. Mr. J. H. Jourdan, in charge of the plant of the Fulton Municipal branch of the Company, has had added to his duties the engineering control of the Citizens branch. The excellence of these appointments goes without saying, and the fairness that dictated them is praiseworthy to the full. We understand that it is but a matter of short time when the manufacturing plant proper of the Brooklyn branch will be closed down, if not dismantled. Other changes, consolidations and re-districtings are well underway, and it will not be long before the permanent shaping of the internal affairs of the Brooklyn Union Company is completed.

REMINDERS OF THE ST. LOUIS CYCLONE.—We are indebted to Mr. Byron E. Chollar, Engineer of the Laclede Gas Light Company, for a set of 19 exceptionally artistic photographs, showing in most vivid manner the damage occasioned to the Company's plant by the tremendous storm which swept over St. Louis several weeks ago. In due time we propose to reproduce some of the photographs, accompanying the illustration with suitable description.

NOTES.—At the annual meeting of the Bridgeton (N. J.) Gas Light Company the reports for the year showed an increase in the output equivalent to 7 per cent. over that of the preceding twelvemonth. The election for officers resulted in the naming of the following: Directors, Daniel Elmer, Dr. Henry W. Elmer, Chester J. Buck, Daniel Bacon and George H. Whipple; President, Daniel Elmer; Secretary and Auditor, H.W. Elmer; Treasurer and Superintendent, B. F. Harding.——During the recent convention of street lighting officials, which was held last month in New Haven, Conn., some of the speakers were rather rabid in their remarks over the unfairness of the lighting companies with which they had to hold business relations. Of course, we will not here attempt either the retort courteous or the slap direct, for the officials have had their "little say," and presumably are the easier in mind for it. We will, however, in view of its appositeness to this matter of holding the lighting companies up as everything unfair and of naming the local authorities as shining exemplars of that which is fair, submit this inclosure from a correspondent at Rockford, Ills.: "Captain Kidd's treasures are not buried deeper or 'lost harder' than the $40,000 which the Rockford Gas Company has invested in about 14 miles of gas mains put in exclusively for street lighting at the instance of the city. These mains were used exclusively to furnish gas for the street lamps. They are in sections of the town where gas is not used, and are wholly unproductive. When the contract with the city expires, Superintendent H. S.Whipple, of the gas works, will begin operations on cutting down the system of mains in this city. The unproductive 14 miles of pipes will be cut off, and $40,000 worth of labor and material will be almost useless. And that is not the only loss that the change in lighting systems in this city will entail to the Gas Company. Under the last contract with the city the corporation was relieved by the Gas Company from purchasing the old lamp posts. Originally the city was under bonds to pay the Gas Company for this material upon the completion of the contract. Now the 700 lamp posts are pretty nearly a total loss. Had they been available a month ago Mr. Whipple could have shipped several hundred of them to another city where the American Gas Company had just made a contract for street lighting. The work of taking out the gas posts will be commenced at once upon the termination of the contract, as the loss of glass because of mischievious boys will be very great as soon as the property is 'dead,' if not gotten out of 'stone reach.' The lamp posts will be taken up and the service pipes cut off at the mains. The 700 posts represent a further investment of $14,000, and the cost of removing them and cutting off the pipes will be fully $700. But despite these changes, which represent the loss of a large sum of money, the Gas Company continues to reduce the cost of gas, having just made its third cut, and Mr. Whipple states that another reduction is in sight. The reductions have resulted in a great increase in the use of gas as a fuel, and the consumption of gas has also been greatly increased by the popularity of the Welsbach burner. No less than 2,487 of these burners have been introduced in Rockford by Manager Whipple in the past few years."——At the annual meeting of the Oswego (N. Y.) Gas Light Company the following officers were elected: President, Jas. Dowdle; Vice-President and Treasurer, John T. Mott; Secretary, R. G. Post.

A Standard Photometer.

[A paper read by MR. W. J. DIBDIN, F.I.C., etc., before the 33d Annual General Meeting of the Incorporated Gas Institute.]

In response to the invitation of the Council of the Gas Institute to suggest, for the purposes of discussion, a form of photometer which should be suitable for general adoption as a standard instrument for testing the illuminative value of coal gas, I venture to offer the following considerations on the subject.

In a paper which I submitted to the Institute in June, 1888, the question of the efficacy of certain forms of photometers was discussed; and, as a result of what then took place, the Gas Referees had all the Evans photometers at that time in use at the official testing stations altered to the form now known as the "Open Evans"—thereby causing that instrument to approximate somewhat to an open bar photometer, but still leaving it in a condition liable to objection.

It may not be out of place to quote here the remarks of the late Mr. Heisch, in the course of the discussion on the paper above referred to:

"He was free to confess that, until the Evans photometers were introduced in the city testing stations, he was not absolutely ignorant of their existence, but pretty nearly so. He had been in the habit of going all about the country testing gas, but never met with one out of the Metropolitan district. They were almost all open bars, and he believed an open bar was the best thing they could possibly use. Free ventilation, both of the candle (or whatever the standard might be) and of the gas, was obtained. Two objections to the Evans photometer, besides its want of ventilation, were: (1) They looked at the disc through a pane of glass, which did not increase the facility of accurate reading; and (2) it was a temptation to a man to take a reading when his eyes were not in the best condition. He would sit in a light room, and just go under the hood, and take his observation. But if he waited (say) one or two minutes after getting under the hood, the observation would probably be different. With regard to the Evans photometer, there seemed to him to be an idea that it invariably increased the apparent light of the gas, and diminished that of the standard. But he happened to have in use two photometers which had precisely the reverse effect, most distinctly depreciating the quality of the gas to a considerable extent. In order to be at all fair to the companies, he took off the bottom trough in which the cords ran, and sometimes the top cover; and he now obtained from the two photometers very much the same results as he did with an open bar—which was most invariably from 1 to 1½ candles higher than he could get before he took off the bottom. He thought this peculiar effect might be due to that circumstance; but, not being quite certain about it, he only threw it out as a suggestion. The disc holder in the center of the photometer happened to fit very close indeed, so that both the heat and the carbonic acid generated principally at the gas end did not find their way beyond it. Therefore, the candles were, comparatively speaking, little affected—there being only a slight rise of temperature, whereas all the carbonic acid was collected on the gas side, and he believed it was this which had the depreciating effect. He mentioned this to show that the Evans photometer did not always work in favor of the gas company."

In considering the most suitable form of photometer, it would appear as if the main point desired was entirely lost sight of, and secondary considerations allowed to have full sway. I propose, therefore, to glance briefly at the primary conditions, and then to adhere to these in any future consideration of the subject.

In the first place, a photometer is but a light measurer, and strictly, has no relation whatever either to the light to be measured or to that of the standard with which it is compared. It has happened that, as a matter of convenience, the surroundings of the burner, etc., have gradually developed until they would seem to be of more importance than the instrument itself. True, if it is desired to affect the quantity of light afforded by either the gas flame or the standard, or both, and so to tamper with the thing to be measured or its measure, then by all means surround them with artificial aids designed to that end. This matter must be thoroughly threshed out before any discussion can take place with advantage as to what should constitute a "standard photometer."

What do we want to measure? Is it the value of 5 cubic feet of gas consumed per hour in a definite burner, under normal conditions in a quiet atmosphere, or do we desire to vary these conditions, and artificially enhance the effect of the burner in producing a certain volume of light? Again, do we desire to measure this light against candles, or any other illuminant which may be employed as a standard, burning, as candles should, in a quiet, properly ventilated atmosphere; or do we desire to shut them up in a hot cupboard, filled with vitiated atmo-

sphere, thus causing them to yield a more or less smoky flame, and so artificially raise the value of the gas flame opposed to them, by debasing that of the standard? On the other hand, is it desired to obtain the result described by Mr. Heisch, and lower the value of the gas flame, while leaving the candles unaffected?

If this point is settled in favor of the production of an instrument which shall be capable at will of yielding the highest possible readings either for or against the gas, irrespective of first conditions, then, by all means let the closed Evans be adopted. Let it be fitted with shutters, apertures with flaps, and ventilating tubes here and there, to be opened and closed at the will of the operator, according as he requires high or low results. By this or that contrivance he may supply fresh warm air to the gas burner, and leave the candles or other standard bathed in their own products of combustion. Or, by reversing the process, we may debase the gas, and allow the standard to rejoice briskly in all the luxury of fresh oxygen. Grotesque as this picture may appear, it unfortunately is only too true; and all photometers must *of necessity* be more or less of this character, whenever they assume the form of a closed instrument.

I presume, however, that what all reasonable men desire is an instrument which will yield results of constant character, as far as the steadiness of the lights under comparison will admit, and which shall indicate the fair and true value of the gas, when burning freely in a properly ventilated room, in terms of a standard candle burning under like conditions. If this point is conceded—and I cannot imagine any other being seriously proposed—the problem solves itself. Burn the gas in an open atmosphere in a freely ventilated room. Let the candles (or standard, whatever it may be) be burnt under the same conditions. Place the disc at the point between the two illuminants where equality is found, and measure from one to the other, preferably by reading a scale (otherwise called the "bar"), which in its essence is only a two-foot rule. Screen the eyes of the observer from direct rays from either light; and we have a perfect instrument, so far as the photometer is concerned.

Doubtless I shall be at once told that I am advocating King's photometer, with Bunsen's disc. Exactly; that was the first form of our most generally used photometer, and I maintain that it is the best. The moment complications were introduced the troubles commenced, and they will continue until all the present "top-hamper" is cleared out, and the much abused gas and candles are again allowed a "fair field and no favor."

I have been much amused at an account of certain experiments made with, or rather supposed to be made with, the pentane Argand standard of light. I say "supposed to be made with," because from the account given I find that the instruments employed were used, or rather misused, in almost every way except that in which they were intended to be used. It seems that two of these standards were placed in an Evans photometer, and were found to disagree. They were then removed and placed on an open-bar photometer, and they were then found to agree. On being again placed in the Evans they disagreed. The remarkable fact about this experiment is that the writer did not see that he was condemning the Evans photometer. How would these standards have behaved in the photometers, so-called, described by Mr. Heisch?

I would suggest the following experiments to those who advocate the use of closed instruments. Let them place a standard Argand burner in each end of an Evans photometer, and consume exactly the same volume of gas from the same main in each burner, and then observe the result. Do the same thing on an open bar. When I say an "open bar" I do not mean a Canadian—that is, a "shut up" bar—but in an absolutely open bar in the middle of a well ventilated room. Then compare the results. To make the experiments with the Evans more marked, readings should be made first with the flaps, etc., open on the right-hand side and shut on the left-hand; and then the process should be reversed.

If we now decide upon the adoption of a simple bar, as first suggested by King, it will be well to definitely state the extent of the departures from his primitive form which modern experience shows to be advisable. These, of necessity, must be limited, or the original simplicity and accuracy will vanish. First, the disc should be mounted in an easily movable box, in the manner recommended by myself some years ago, and now generally adopted—viz., so that both the disc and mirrors can be rotated after the first half of the set of readings has been made. Second, a velvet curtain should be hung at the back of, and 12 inches from, each light, to prevent reflection from walls, etc., on to the disc; and another in such a position as to shield the eyes of the observer from direct rays. Third, the table on which the photometer and burners stand should be as near the middle of the room as possible, so as to avoid those currents of cooled air which, especially in cold weather, fall down against the walls. Fourth, the room should be properly ventilated, without draught, and should be kept at a temperature as near 65° F. as possible. Fifth, the room need not of necessity be painted black, a subdued dead-wash being amply sufficient for all purposes.

A modification in the manner of recording the readings has been sug- to me by Mr. A. F. Damon, one of the London Gas Examiners, which seems to promise very well. This is to place a paper scale on the photometer bar, under the disc box; and instead of the observer reading off each observation as at present, he should impress on the paper, by means of a spring pointer, the position at which the disc stands at the moment of observation. As each impress of a series of 10 readings could be made to fall on the paper scale at positions a little lower than the previous one, the order in which they were made would be seen at once. The advantage of this alteration would be that of necessity the observer would be unbiased in his readings by not being able to see the scale at the time; and, further, the impressed scale would be preserved for future reference.

The suggestion has been made that the gas should be burnt in quantity sufficient to fill the burner with flame, and the value ascertained by measuring the quantity of the gas consumed and calculating the intensity yielded by a constant volume, by reducing the readings in ratio to the consumption. This question, however, affects the character of the burner to be employed, and not that of the photometer; as in any case that instrument should remain identical in character, whatever the burner employed, or the method of its use.

The proposal to use the modified Foucault photometer, suggested by Mr. Vernon Harcourt, is decidedly good, in that it necessitates the two illuminants being burnt in the open, and entirely unaffected by screens or draught regulators, which, as already shown, soon become converted (intentionally or not) into apparatus for altering the conditions affecting the combustion of the gas or standard, or both. This instrument is tantamount to bending the photometer bar at its center, bringing the two ends nearly together, and placing the disc at the apex of the triangle so formed, so that it faces the observer. The use of slits in a brass diaphragm enables respective portions of the greased paper to be illuminated by the opposed lights, when the intensity can be equalized either by moving one of the illuminants or altering its value by varying the volume of the gas consumed in the standard burner.

The alterations required to existing photometers, to bring them into accord with this method, virtually amount to a new instrument; but as any ordinary bar photometer can readily be arranged to make it comply with the conditions I have suggested, the desirability of such a complete substitution does not seem to be very urgent—especially as the table photometer would bring into use a method of reading to which few are accustomed. These objections, however, are trivial, if it be really deemed desirable to make such a complete change in existing arrangements. The great point is that the two lights should be burnt without artificial aids of any kind; and this is assured with either King's "bar" or the "table" photometer.

Photometers and Standards of Light.

[A paper read by Mr. William Sugg before the 33d Annual General Meeting of the Incorporated Gas Institute.]

It will be readily conceded that the photometer, with its accessories, forms one of the most important pieces of apparatus on a modern gas works, because it is the means by which the engineer verifies the illuminating power of the gas which he supplies to the public, and satisfies the municipal authorities that the terms of the company's contract under this head are fulfilled. Thus the photometer is, or should be, a standard measure, consisting of three important parts—viz., the standard burner and chimney, suitable to consume 5 cubic feet per hour; the standard spermaceti candles, serving in this country and its colonies as the standard of light with which the gas is to be compared; and, finally, the photometer bar and its disc or screen, by means of which the gas examiner fixes the exact distance between the two lights where the light is found to be equal on both sides of the disc. At this point he finds the number of parliamentary candles required to equal the gas in light-giving power.

There are meters fixed in every consumer's premises which register the quantity consumed with commercial accuracy; but the monetary value to the public of the gas thus supplied depends largely on the amount of light to be obtained from a given quantity of it. Parliament, in granting statutory powers to gas companies and corpora-

tions, has for many years past recognized this fact; and in almost all the Acts which confer these powers it is stipulated that certain photometers and burners shall be used, in conjunction with proper candles carefully burnt in a certain manner, in the verification of the statutory illuminating power of the gas supplied—penalties being incurred in case of failure to comply with the terms of the contract. It is, therefore, evidently of great importance that the details of the photometer and its accessories should be rigidly adhered to by both parties to the contract.

The object of this paper is to ventilate this question, in view of the fact that there appears to be a disposition on the part of some municipal authorities to adopt certain modifications in the photometer itself, and in the method of using it, which would have the effect of raising the parliamentary standard and increasing the initial cost of maintaining that standard, without in any way compensating the suppliers of gas for the extra illuminating power thus required. In one case now before Parliament a powerful corporation, with a Lord Mayor at its head, have not scrupled to stigmatize the photometer originally adopted in the Act regulating the illuminating power of the gas to be supplied to their city as an "obsolete" instrument; and have brought a Bill into Parliament to authorize another photometer to be used, differing materially from that prescribed in their Act, and, more than that, to considerably alter the conditions of supply, making them more onerous and difficult for the gas company. It is noteworthy that the photometer in question was re-imposed only a year or two back as a result of arbitration. If this corporation can succeed in their object they will doubtless have imitators, and finally the whole system of the supply of gas under Acts of Parliament by gas companies, and even corporations, may be thrown into confusion.

In order to facilitate the judgment of this Institute the author feels it necessary to go a little into ancient history, which he hopes, however, will not be uninteresting. The standard burner to be used is defined in a large number of the gas companies' Acts as an Argand, mostly followed by the words "or other approved burner." Sometimes it is only referred to as a 15-hole Argand, with a 7-inch chimney. About one-half of the gas companies in the United Kingdom are in this category. In a few cases no standard burner or standard of illuminating power or photometer is mentioned, such important cities as Manchester, Worcester and Warwick being in this latter category. There are a few companies—such as Liverpool—who use the Gas Referees' flat-flame burner (Sugg's No. 7) as a standard for testing 20 or 21 candle gas. In the Dublin Act alone a "suitable" flat-flame burner is prescribed for testing 16-candle gas. Now, there is no standard flat-flame for 16-candle gas.

It will be necessary here to state that most of the companies and corporations whose Acts vaguely describe the standard burner have adopted the "London" Argand No. 1, as prescribed by the London Referees, as an "approved burner." Some have this burner made with 15 elongated holes, because the Act specifies that the number shall be 15, but omits to mention the size or shape of these holes. This curious circumstance, it is believed, was evolved out of the controversy originated by the late Mr. Samuel Hughes, who took the view that, in the interest of the public, he had a right to have the gas tested by the worst burner he could find. The worst Argand burner to consume the statutory quantity of 14 or 16 candle gas is that with an iron top and 15 holes, each of about 1-100th of an inch in diameter.

The next worst is a *chef d'œuvre* for which Mr. Samuel Hughes was primarily responsible—viz., the old Birmingham 15-hole, with a bell-metal top, used with a 7-inch chimney, for testing 14-candle gas. It is needless to say that Birmingham has got rid of it, and now uses the "London" Argand. This unfair view taken by Mr. Hughes was to a very great extent disposed of by the House of Commons Committees sitting under the chairmanship of Mr. Sotheron-Estcourt and Mr. Cardwell, in 1867–68. They both found that the view adopted by Mr. Hughes was wrong. In the result they directed, in the City of London Gas Act, that the Gas Referees were to fix upon a burner which would at the same time be the best for the consumer as well as the best burner for developing the illuminating quality of the gas, to be used as a standard burner for testing the gas.

But notwithstanding this judgment of the Parliamentary Committees, there remained an indisposition on the part of those who promoted Gas Bills, as well as on the part of those who opposed them, to properly define the standard burner. In consequence of this there has always been more or less divergence in the actual and nominal illuminating power of 12, 14 and 16-candle gas in various parts of the country. When it is considered that from time to time statistics have been, and are still, published, and evidence given before Parliament, in which comparisons are made of the prices at which gas is supplied to the public in different cities and towns, it is evident that these divergencies in the standard burners must have led to a considerable amount of misapprehension, and even injustice in certain cases. Everyone will agree that 12, 14, 16, 18 or 20-candle gas ought to mean the same quality in every part of the British dominions. Yet it is undeniable that this is not the case. It is a very significant fact that the only standard burner which has been acknowledged as such by the Standards Department of the Board of Trade is the Gas Referees' 14 and 16-candle burner—one burner being used, with different sized chimneys, for both qualities of gas.

The only other standard burner which has been accurately defined by Parliament is the Sugg "Preston" Argand burner for 18-candle gas. There is no 12 or 20 candle Argand standard burner prescribed or approved by Parliament, nor is there any 25 or 30-candle burner for Scotch gas. The Gas Referees' flat-flame standard is of a vacillating character; and, like most other flat-flame burners, it is not at all suitable to develop the true illuminating power of the gas, especially when it happens to fall a little below the standard, or when it is well above it.

The author begs to submit a photographic view of the behavior of a flat-flame burner in a photometer, consuming the statutory 5 feet per hour of 18-candle gas, in a room free from draught, excepting that produced by the natural movement of the air therein, promoted by the

Fig. 1.—View of Flat Flame Burning in Photometer, Looking on to the Edge of the Flame.

burning of the gas itself and the necessary movement of the gas examiner in making his observations. This will strongly support the opinion of the author that a flat-flame burner (or, as the French call it, a *flamme libre*) is not a proper standard burner to test gas with. The exposure was two minutes, and the burner and flame are shown natural size.

It will be well here to state a fact in the ancient history of burners used for testing gas, which is vouched for by the author, and will throw some light on the statements occasionally made as to the quality of the gas supplied in the years before 1863. In the year 1847 the author was taught by the late Mr. Thomas Livesey the method of testing the illuminating power of the gas supplied by the South Metropolitan Gas Company, which was then considered to be 13 candles per 5 cubic feet. The burner was an Argand, with a 7-inch chimney; and it had 15 holes in it. These holes, when the burner was new, might be about $\frac{1}{100}$ of an inch in diameter; and they were carefully kept uniform in size by

means of a small taper brooch, very little larger than $\frac{1}{100}$ of an inch in its thickest part.

Some years after this, the author found in use at the Chartered Gas Company's works, for testing their gas, an Argand 15-hole burner, which was larger, however, in diameter than that used at the Old Kent Road works. Subsequently at Fulham Gas Works, Mr. Thomas Kirkham showed the author another 15 hole Argand burner, with a platinum top, with holes a little larger than the South Metropolitan burner. It was afterwards discovered that the South Metropolitan burner was a relic of the time when the late Mr. Palmer was Engineer of the Company, which, under his direction, manufactured cannel gas. The Western Gas Company at Kensal Green, also under the direction of Mr. Palmer, used an Argand burner with 15 holes, similar to that employed by the South Metropolitan Gas Company. It is most likely that, when Mr. Alexander Wright was Engineer to that Company, they used a flat flame burner of some sort, because he appears to have been in favor of them; but no burner was specified.

The other London gas companies—viz., the Imperial, Chartered, South Metropolitan, Phœnix, Commercial, Ratcliff, London, Great Central, and Independent—used Argand 15-hole burners, fitted with 7-inch chimneys, as did also the different Gas Examiners—Dr. Warrington, Dr. Letheby, Dr. Leeson, Dr. Graham, Dr. Brand, Mr. Lewis Thompson and others. It is very remarkable that the 7-inch chimney, by 2 inches external diameter, seems to have been employed with all the 15-hole burners for gas of 12, 14, 16 and even 18 candles. It could not possibly suit them all, nor could it suit the different diameters of the 15-hole burners; but it was used nevertheless. No two burners were exactly alike. They differed in many important points; but it was generally supposed, up till 1858, that no matter what 15-hole burner was used, the result in illuminating power with a consumption of 5 cubic feet was about the same.

In 1857 the author of this paper obtained leave to try some 8 or 10 Argand burners used by the London Gas Companies and the Gas Examiners; and the result of testing them all with the same gas and photometer was a difference of about 5 or 6 candles between them. The quality of the gas supplied by the different Companies was supposed to be from 12 to about 16 or 18 candles; the Western Cannel Gas Company being the highest in quality. The rest of the Companies supplied what we should now call from 13 to 14 candle gas, as far as the author was able to judge. It is not astonishing, therefore, that a difference of 25 per cent. between the experts on the one side and on the other was a common thing.

It was not till 1858 that the late Mr. George Lowe, F.R.S., and Mr. F. J. Evans took up the question of the adoption of a standard burner—moved thereto by the results of the author's experiments, which they verified. In parentheses, the author remarks that it was very curious that Mr. George Lowe, in Finsbury Circus (where he had his laboratory), used an Argand burner invented by a Mr. Leslie, a tailor in Regent street, in the West End of London. This ingenious burner had a number of tubes from which the gas issued, instead of holes. Mr. George Lowe first explained, personally to the author, the effect of long and short chimneys upon the illuminating power of gas consumed in an Argand burner, illustrating the damaging effect of a long chimney upon a Leslie burner. The Leslie burner he used generally with a 3-inch chimney. Excepting for the regularity of the flame and the diminution of the shadow, it was not generally known that this burner was any better than any other consuming a like quantity of gas.

However this may be, it was Mr. George Lowe who presented to the notice of a Committee of the House of Commons the first attempt at a standard burner made by the author. This was a 15-hole Argand, with a top drilled with holes nearly $\frac{4}{100}$ths of an inch in diameter, instead of the iron one with small holes, and with the inevitable 7 inch by 2 inch chimney. It was promptly rejected by the Committee, at the instance of Mr. Samuel Hughes. The author mentions these facts because it is very important, in view of various statements made from time to time in Parliamentary Committees by expert witnesses, to show how very little the real illuminating value of the gas supplied by different companies could have been known at that time.

By the continuous interest taken in the question of illuminating power by Mr. George Lowe, Mr. William King of Liverpool, Mr. F. J. Evans, Mr. T. N. Kirkham, and, on the part of municipal officers, by Dr. Warrington and Dr. Letheby (to all of whom the author was deeply indebted for instruction and help in this work), the system of photometry now in use all over the kingdom, and the settlement of the standard burner and other apparatus necessary to more accurate working, first obtained a start. The adoption of the Sugg-Letheby 15-hole Argand burner was the first step towards uniformity in properly burning the statutory quantity of the gas to be tested. Adopted by Dr. Letheby in 1863, this burner become largely used throughout Great Britain and her colonies for testing gas, as well as for the purposes of lighting. It never, however, became a standard burner, most probably because of the continued opposition to those who adopted the Hughes theory; but it undoubtedly led to a generally greater accuracy in testing gas, and therefore to a more accurate knowledge of its cost.

Proceeding now to the photometer on or in which the standard burner is used, it is remarkable that the Gas Works Clauses Act of 1871 adopts the two photometers which were prescribed for use, under their authority, by the Gas Referees for London in 1870, after serious investigation. These were the well-known Letheby and the Evans photometers. Previously to the adoption of these instruments for gas testing purposes by the Gas Referees, a variety of other photometers were in use, which gradually were superseded by those above mentioned.

Amongst these latter, it is interesting to mention the photometer of Count Rumford, which is shown in "Clegg's Treatise on Coal Gas." This instrument was an inclosed photometer; and the gas was probably burnt in an Argand burner either of the Clegg or the Bynner type. The burner was placed at such greater distance from the point of comparison than the candle that the light from the candle would, at the shorter distance from the point of comparison, equal the light of the gas at a longer distance. The light given by the gas was probably about 12 candles; and the distance of the candle from the point of comparison, squared, would go twelve times into that between the gas and the point of comparison likewise squared.

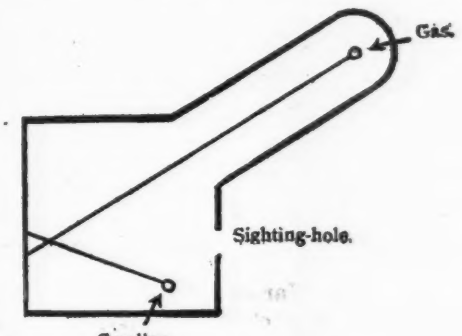


Fig. 2.—Rumford Photometer.

This point of comparison was a piece of white paper, on which the shadows of a small stick were separately projected by the respective lights to be compared. The observer looked through a sight-hole in the front of the box. If the shadow produced by the gas was not equal to that produced by the candle, the gas was turned up; but if, on the contrary, it was more than equal, the gas was turned down. The quantity of gas was doubtless measured by Count Rumford himself, although it is very probable it was only roughly measured by the height of the flame, in practice, for gas testing.

This instrument was modified by Foucault, the French scientist, and adopted by Dumas and Regnault in drawing up the *Traité* made between the Paris Gas Company and the municipality, in 1858, which is still in force. The Paris instrument is closed in front and open at the back. As regards the position of the lights, the author ventures to think that the idea of Count Rumford is the better of the two, because the direct rays of the gas are more shaded from those of the candle. Instead of the hole through which, in Count Rumford's photometer, the comparison between the shadows was made by the observer, Dumas and Regnault adopted what they called a *lentille*—or eye-piece—through which the examiner compares the degree of illumination produced by the gas light and the standard of light, upon a screen made by grinding fine rice mixed with gum between two pieces of glass. It is to be noted that the examiner can only use one eye at a time. This is not an improvement on the Rumford photometer.

The author mentions these instruments because one of the latest photometers, designed by Professor Vernon Harcourt, F.R.S., and proposed to be used for testing the gas supplied to London, is very much on the same lines as these older instruments. The Professor does not, however, use the *lentille* adopted by the French; and it is believed that he desires to inclose the instrument by black velvet curtains, to cut off reflected rays from the walls of the room in which it is used, which is not done by the French. In all these, the equality between the lights must be obtained by turning the gas down or up.

The author is of opinion that this method, which answers well in France, is unsuitable to the comparatively very rigorous methods of

testing adopted in England. A not very decided man may turn up the gas and turn it down again many times during an experiment, before he satisfies himself that the two lights equally illuminate the screen—more especially if the colors differ. Thus the quantity of gas used to equal the standard light may be inaccurately registered, and the result be rendered doubtful. The standard for France is the Carcel lamp, which is equal to 9,5 English candles.

Now, under the Gas Works Clauses Act, the average of two tests taken at any time between the proper hours would, if they were below the standard to any extent, subject the supplier of such gas, if a company, to penalties. In France generally some hundreds of tests, extending over a considerable period of time, are required to penalize a company. The Paris Gas Company is allowed a three months' average of the results obtained every night in the 23 arondissements of Paris. Therefore the Paris photometer and the French standard of light (the Carcel lamp), need not be practically considered in relation to the testing of gas in England.

It is here necessary to say, in speaking of Professor Harcourt's photometer, that he proposes to use his pentane Argand as a standard of comparison, instead of either the candle or the Carcel lamp. This, together with his tracing-paper screen, which is seen by both eyes at once, constitutes a most important difference between his proposed photometer and the Foucault and Rumford instruments.

Previous to 1858 there were three types of photometers in use in Great Britain—namely, King's 100-inch photometer, the Church and Mann photometer (Fig. 3) and a kind of flat-rule 60 inch bar, fitted with a Bunsen disc without any screens, employed by Dr. Letheby in his laboratory at Finsbury. All these instruments were used in darkened rooms with blackened walls. From these two latter was evolved the well-know Letheby 60-inch photometer, in or about 1863.

Mr. George Lowe used in his laboratory at Finsbury Circus, in 1858, a small inclosed photometer, about 4 feet long. In it he used a Leslie Argand burner with a 3-inch chimney, consuming 5 cubic feet of gas per hour; and as a standard of light he employed a jet of the same gas as that used in the Argand burner, regulated to a height of 2½ inches. He carefully adjusted this jet by means of a pair of steel compasses; and the light given equaled a candle. From a considerable knowledge of this instrument and standard, the author can testify that the results obtained by Mr. Lowe were remarkably accurate; but it must be considered that he controlled the correctness of his experiments by means of the jet photometer, which he had invented and given to the author. Mr. Lowe used his little photometer in an ordinary room, slightly darkened by means of black calico blinds. In like manner as the Letheby photometer was evolved from King's, it is quite possible that the first idea of the Evans photometer was obtained from that used by Lowe.

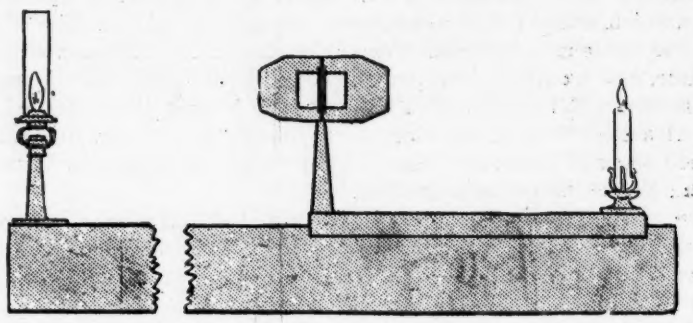
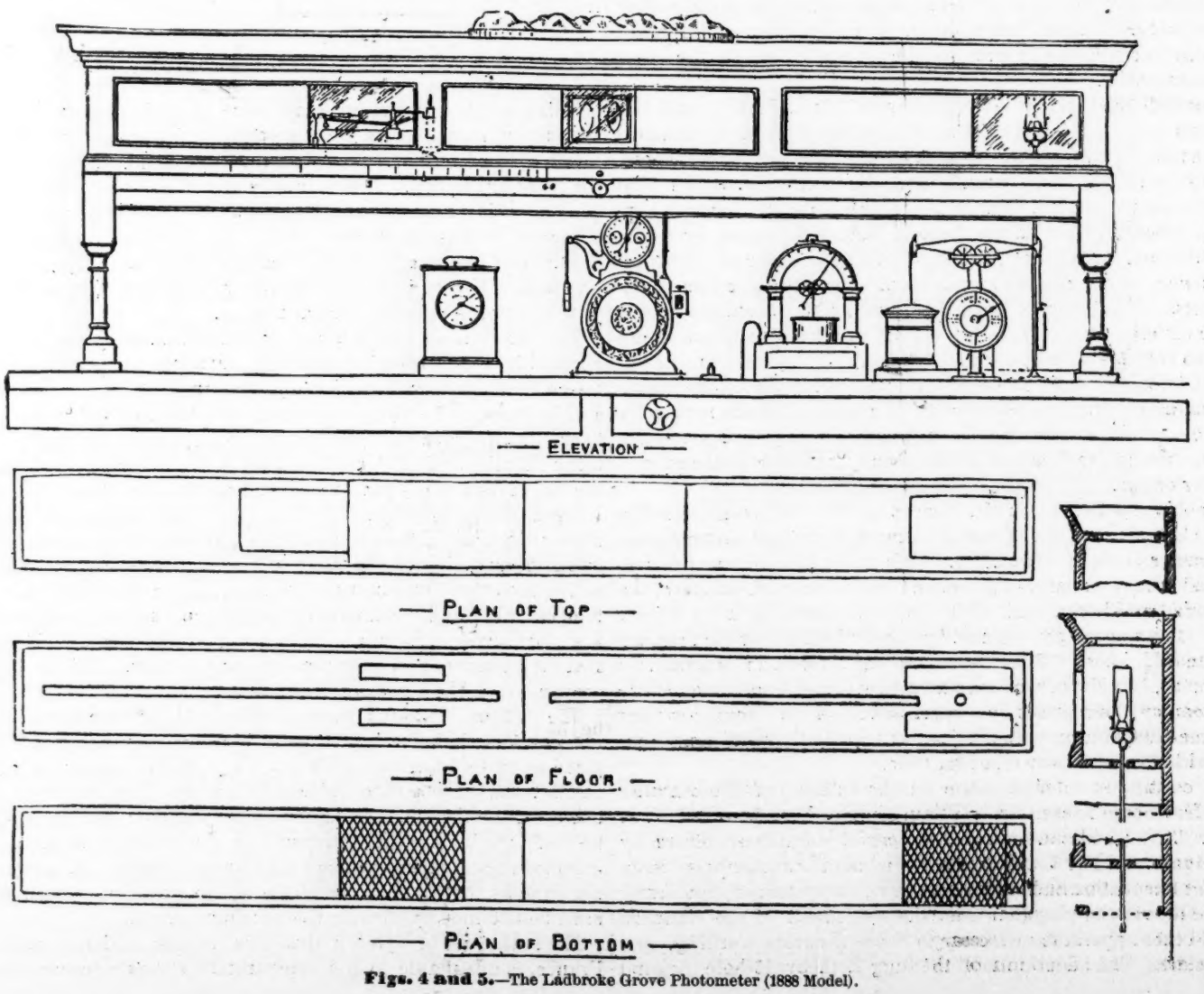


Fig. 3.—Church and Mann Photometer. Candles and disk both moving together at a constant distance one from the other.

It may comfort many engineers who have occasional trouble with candles, to learn that Mr. George Lowe rarely used them. There was a noble pile of spoilt and rejected candles alongside his photometer; but from the time he had found his 2½-inch jet and his jet photometer, he never trusted any more in candles. The author cannot say that there appears to be much more confidence in the minds of the engineers of to-day as regards candles.

Of the two photometers prescribed in the Gas Works Clauses Act, one of them—viz., the Evans—has been modified by the present Gas Referees for London; and this modification (shown in Figs. 4 and 5) is in use in 10 out of the 23 London testing stations. The first Evans photometer to be modified was that at Ladbroke Grove, and it is consequently known as the "Ladbroke Grove" pattern of the Evans photo-



Figs. 4 and 5.—The Ladbroke Grove Photometer (1888 Model).

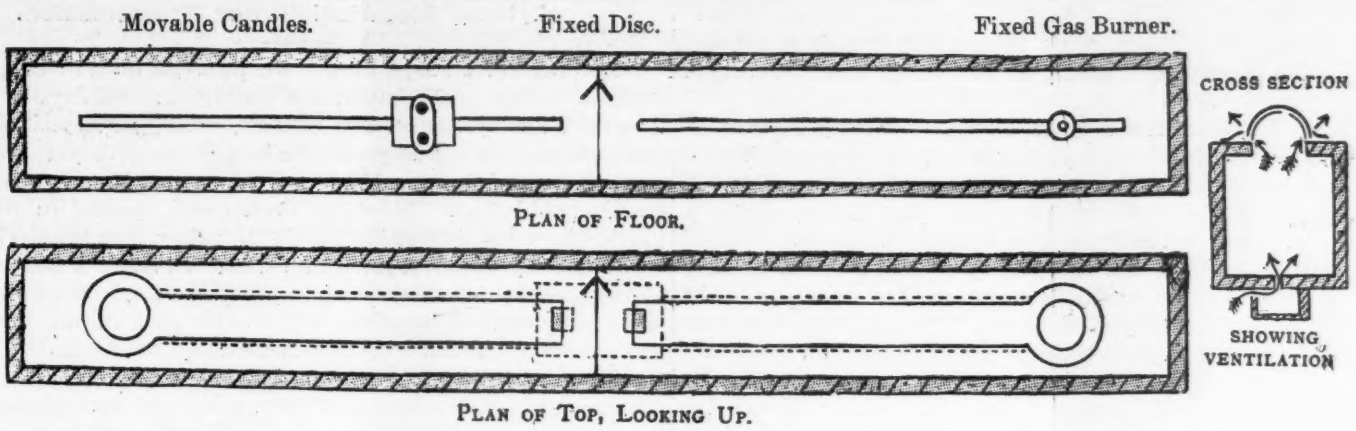


Fig. 6.—Evans Photometer (1878 Model).

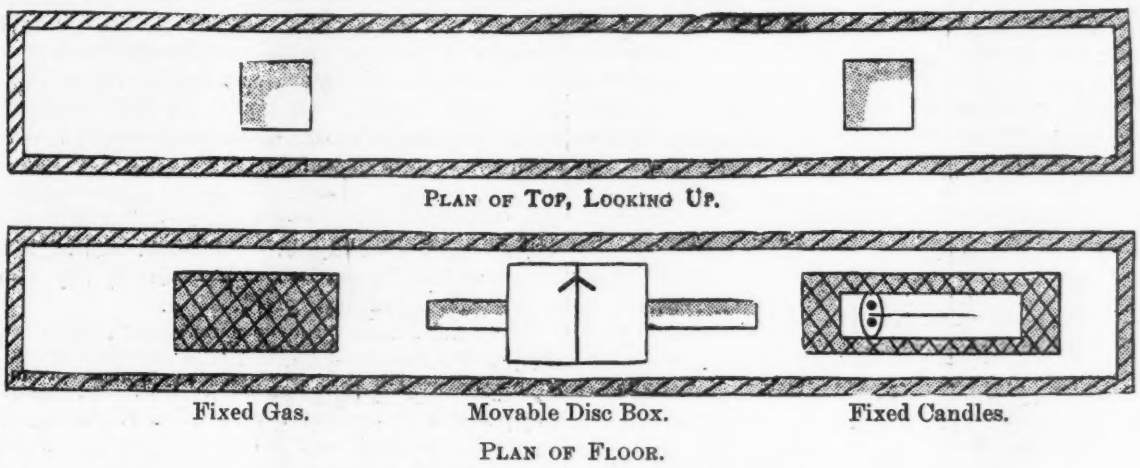


Fig. 7.—Evans-Letheby Model at City Testing Stations.

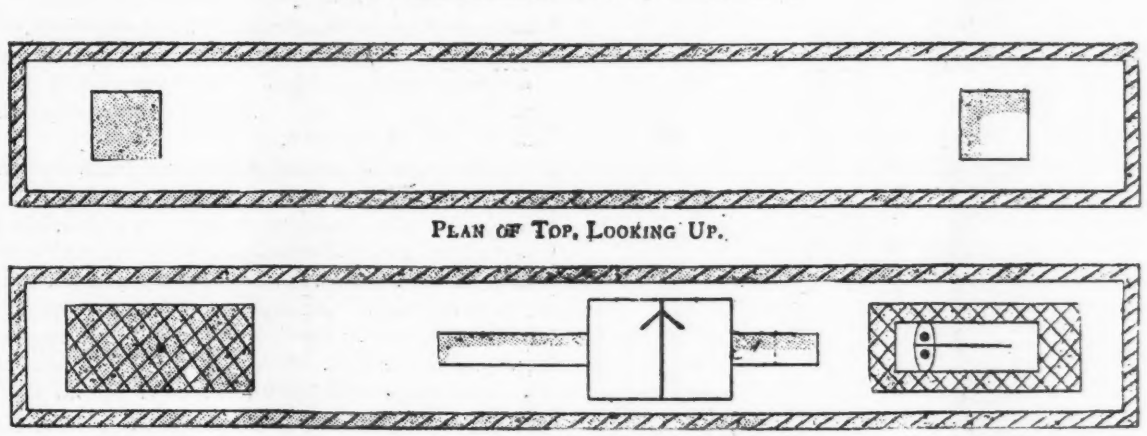


Fig. 8.—King-Evans Photometer (1892 Model).

meter. This modification was made in 1888, in consequence of some experiments undertaken by the Gas Referees and Mr. Dibdin, the Chemist to the London County Council. The results obtained are said to have been phenomenal; 16-candle gas having been found to be in some experiments as high as 19 candles and more.

The author, although he was the maker of this photometer, was not asked to be present at any of these tests; and he desires to remark that, in his opinion, the wild results obtained must have been due to the state of the weather combined with inefficient ventilation of the room, because photometers of precisely the same form and dimensions as the original Evans give constantly, in a large well-ventilated room, exactly the same results, with the "London" Argand burner, as does the Letheby photometer—the alternative one prescribed in the Gas Works Clauses Act. There is one thing which probably might have conduced in no small degree to produce the above mentioned erroneous results, and that is the doors of the photometer might have been kept closed for a much longer time than was required to perform a proper experiment—viz., 10 minutes, or rather 9 minutes. The Gas Examiner at this station had for some years been making his tests with the same instrument, without finding such extraordinary results.

The author has carefully tested many of the original Evans photometers alongside the Letheby and Canadian photometers in a well-ventilated room, and found them to give like results, when the doors of the Evans photometer are opened after each completed test. As keeping the doors closed for a long time goes in favor of the gas, no gas examiner desirous of fairly doing his duty would work in this way.

It is probably the report of these experiments, and the knowledge that the Gas Referees ordered the Evans photometers under their jurisdiction to be altered, which led to this photometer being called "obsolete" by persons who do not bear in mind that the contract to supply gas of a certain quality implies likewise the continued use of the photometer as it was at the time when the contract was made. It is now more than 35 years since the original Evans photometer (Fig. 6) was invented; and it might, with our present knowledge, be improved. But, on the other hand, so might the standard burner; and so might also the British yard measure, in the same sense.

As regards the photometers prescribed in the Gas Works Clauses Act, it must be borne in mind that there is a choice of two instruments; and therefore it is clear that, if one of them is not liked by either party to the contract, they can take the other. Both of these instruments may be compared, and it can be very easily demonstrated if there is any defect leading to erroneous results in either of them. Both ought, with

reasonable care, to give the same results for the same gas; and I have no doubt they always will. It should be said that, in making my tests of every kind of photometer, I mostly use the pentane standard of light, and rarely any other.

There is, besides the Ladbroke Grove modification of the Evans photometer. another modification adopted by the Gas Referees which is used in the three city of London testing stations. They are alike, and each is a combination of the Evans and Letheby photometer; a Letheby 60-inch bar being put inside a 100-inch Evans photometer. The old Evans scale is abandoned; and the readings are taken on the Letheby scale. The lights are fixed. and the disc moves. This form is called by the author the Evans-Letheby (Fig. 7); and it is found to work well and accurately with an Argand burner. The Warden of the Standards has stamped several photometers which are combinations of King's 100-inch bar photometer and the Evans photometer. King's 100-inch bar is put inside the Evans photometer. This form was first made in 1892. (Fig. 8).

Of the other photometers used in London, there are two of the Imperial standard pattern on the Gas Light and Coke Company at Hornsey and Westminster; two of the Canadian Government pattern on the South Metropolitan; and six of the Tooley street pattern on both the Gas Light and Coke Company and the South Metropolitan Gas Company. All of these, judging by the daily returns, seem to give equally accurate results. It is to be noted that the "London" Argand

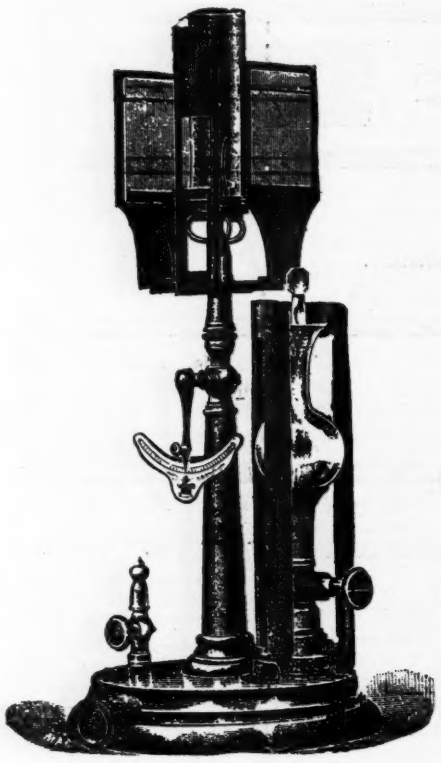


Fig. 9.—Pentane Argand Burner with Carbureter.

is used in all these stations. Fig. 9 shows the pentane air gas standard of Professor Harcourt and Mr. Dibdin.[1]

In conclusion, the author begs to say that, having put before you these particulars relating to the question of the photometers and standards of light, he thinks that what he has said will be found useful in aiding you to arrive at a just decision upon these important questions, as regards the contract made in your Acts of Parliament with the purchasers of gas whom you respectively supply. The author's own opinion is that, since 1881, the purchasers and suppliers of gas have gradually come to a very good understanding as to the fair interpretation of the different Acts of Parliament, and in almost all cases have agreed upon one or other of the two photometers and approved burners. There is no urgent necessity to disturb this understanding. If the pentane Argand were adopted by mutual consent, in place of candles, the whole question of testing the illuminating power would, in almost all cases, settle down into satisfactory working order.

1. Mr. Sugg at this point called attention to the question of the make of candles as bearing upon photometric results; and this matter was referred to in the course of the discussion. The 10-candle pentane Argand standard was tested with two different makes of candles on the same day; and in one case its value was given as 10.4 candles, and in the other as 9.97 candles.—Ed. J. G. L.

A Long Electrical Power Transmission.

According to *Iron Age*, Fresno, the principal town of the great San Joaquin Valley, in California, was during the last days of May the scene of the completion of a great work, having for result the electrical transmission commercially over the longest distance yet attempted of power generated by an artificial fall of water which is unique in its creation and height. The city of Fresno was founded in 1872, when the Southern Pacific was first laid in the valley. For 13 years its growth was extremely slow, but in 1885 it received an impetus and in the last 10 years its population has risen to 15,000 persons. Its natural advantages are many. It is the center of a fertile agricultural region, overspread with a network of canals and ditches for irrigation purposes, and has vast mineral resources as yet undeveloped. It is the commercial center of the San Joaquin Valley, and would have become a manufacturing city had its aspirations in this direction not been subdued by the extremely high price of fuel and consequent heavy cost of power for manufacturing purposes. All manufactured articles had to be purchased in the East, and when to their cost was added the freight and charges, prices on arrival at Fresno became almost prohibitive. The utilization of the difference of level of the San Joaquin river had been mooted, but not until the successful solution of the problem of long distance power transmission had been reached did the utilization of the San Joaquin become possible. A Company was formed, the San Joaquin Electric Company, to carry out the work, and the General Electric Company's project and three-phase system of transmission was adopted. The work, lacking a few details, is now complete, and Fresno is on a par with any city of the East so far as the cost of power and light is concerned.

The Hydraulic Plant.—The source of the water power is the North Fork of the San Joaquin, which at the point of diversion runs through a narrow canyon with solid rock walls. The minimum low water flow of the stream at this point is 50 cubic feet per second, which at the head used will develop over 7,000-horse power at the water wheels. From the point of diversion a flume has been built and a canal excavated and carried along the slopes of a hill for a distance of 7 miles. They run along a right of way, cleared of all obstructions, for a width of 150 feet. The grade is 5.28 feet to the mile, and the lower bank forms a roadway for the inspection wagons. The entire system of headworks and canal is below frost line, and is, therefore, not exposed to any deleterious effects of snow and cold.

At the end of the canal is a natural basin several acres in extent, surrounded for about three-quarters of its distance by a dyke of rock, which, for an expenditure of less than $3,000, has been continued in an embankment for the remaining distance and a reservoir for storage water formed, which, at a maximum depth of only 10 feet, will be sufficient to operate the plant at full load for several days consecutively. This provision will allow of the ditch and flume being shut off in case of repair or changes. The reservoir is located at the top of a high hill, the river being some 1,600 feet below. From the pressure box in the reservoir the pipe line, 4,100 feet long, is brought down the mountain side, and in this distance the difference in level between the water in the canal and the water in the river below is over 1,400 feet. For the first 400 feet the pipe is steel riveted; the balance is lap welded pipe with lock joints, and at the lower end is ¼-inch thick by 22 inches in diameter.

At the power house the pipe enters a receiver 57 feet long by 30 inches in diameter, of ¼ inch steel, with joints of the butt strap type. This receiver is designed to stand a working pressure of 800 pounds to the square inch.

The water wheels are of Pelton make, 57 inches in diameter, each capable of developing 500-horse power at 600 revolutions per minute under an effective head of 1,410 feet, the highest head ever used for power transmission purposes. The wheels are constructed with steel plate centers and bronze buckets, and are fitted with flywheels 5 feet in diameter. Separate wheels are provided for the exciters. The wheels which drive the generators are provided with Pelton differential governors.

The Electric Plant.—The electric plant consists of three General Electric 3-phase generators, each of 350 k.w. capacity at a speed of 600 revolutions. The armatures are directly connected to the water wheels by insulated flange couplings. The exciters used are of the slow speed multipolar type. The current from the generators is delivered to six 125 k.w. step up transformers of the General Electric air blast type, with secondaries wound for 11,200 volts, to which pressure the current in the transmission line is raised. Provision is left in the generator room for three more transformers of similar capacity. From the trans-

formers the current passes to the switchboard, which is of Vermont marble highly polished, as are all the other switchboards used in the installation. The switchboard consists of six panels, three of which are generator panels, one exciter panel and the other two operate the combination of the six transformers and carry special high tension line switches.

The 11,200-volt circuit, consisting of six bare copper wires, leaves the power house at the upper end, runs up the stream a few hundred feet, crosses the San Joaquin river with a span of 275 feet, and is then led up the mountain for a distance of about 2,000 feet. The line continues for about 10 miles through a rolling, hilly country, easy of access and at all times below the snow line; the rest of the line runs over a flat country, and near Fresno passes through wheat fields and vineyards and follows a special right of way and wagon road for the entire distance. The total length of the transmission line from the power house to the sub-station is little short of 35 miles and is thus the longest commercial electric power transmission in the world. The line is strung on special high tension porcelain insulators tested under 27,000 volts alternating before shipment. The poles are square redwood, 35 feet long, set 6 feet into the ground and fitted with three heavy cross arms and one small cross arm for telephone wires.

The sub-station at Fresno is almost in the center of the business portion of the city, and is a brick structure 55 feet by 45 feet. The high pressure circuits entering the house are brought to nine step-down transformers, also of the air-blast type. Three of these are of 125 k.w. capacity and reduce the pressure to 200 volts, three of 75 k.w. capacity, with secondaries of 1,000 volts, and three are of 40 k.w. capacity, reducing the pressure to 3,000 volts. In addition to these transformers the station also contains two 80 light Brush arc machines directly driven by two 60-horse power 3-phase induction motors.

The system of distribution from the sub-station is divided up into three networks. The first, a 200-volt 4-wire low tension network which covers the business portion of the town and has an initial capacity of 6,000 16-candle power incandescent lamps. The second, a 1,000-volt 3-phase system covering the residence districts of the town and having an initial capacity of 4,000 16-candle power incandescent lamps. The third, a 3,000 volt 3 phase circuit designed to furnish current to the numerous vineyards and wineries within a radius of 10 miles from the sub-station for both lighting and power purposes. Motors will also be furnished with current from both the 200-volt and 1,000 volt systems.

The policy of the operating Company is of a liberal character, the end in view being the stimulation of the use of electric power. To effect this end prices are made which compare favorably with that charged for power where coal costs only $2 per ton. The result of this is that the demand has already taxed the resources of the Company, although the plant has not yet been running for one month.

The Fireman and Fuel Efficiency.

By Mr. C. C. Dennis.

I shall be much gratified if the following remarks shall meet the eyes of the proprietors of steam power plants, as well as those of the individual in whose interest they are made. I hope to set forth the relative importance of each in connection with the operation of steam plants, and also to show that the man with the shovel holds an important relation to the balance sheet, as well as to the continuous and successful running of the plant. Also that the interest of the proprietor is found in a proper recognition of the importance and value of the intelligent fireman.

My conclusions are based on an active experience, running through the years that cover the evolution of steam power from the "shot gun" variety of slide valve engines up to the triple expansion compound condensing, and from the "cylinder" to the multi-tubular fire and water tube boilers, and I think are fully warranted by the conditions as they exist to-day.

Ordinarily, the engineer is considered to be the important intermediate between the office and the coal pile, and I would not in the least detract from his value, in his position, whether he combine both avocations in one—fireman and engineer—in a small plant, or is in charge of a larger plant, where the engine room gives him full occupation.

The idea that because a man is a good engineer he is a good fireman, or the reverse, is unreasonable; the two vocations are as separate as the sawyer and the builder. The engineer is required to maintain the efficiency of machinery committed to his charge, and see that the results pledged by the manufacturers are obtained and maintained. His education and training have made his duties plain and reasonably simple. My contention is that from the fireman there is required a higher order of skill and ability, and that he should be fitted, by education and investigation, coupled with experience, to obtain in the firebox of his boiler the largest possible yield of power that the fuel furnished to him is capable of. He owes this to his employer, who should be satisfied with nothing else. The intelligent fireman presupposes an intelligent employer, one who, in his care for his interests, has learned the possibilities in output of all his purchases. If he buys wheat he expects a certain output in floor; if leather, the output of shoes; if cotton, the output of cloth, and he expects the best quality of each, and as he buys coal, he has a right to expect the largest output and the best quality of steam. As he has purchased the most approved manufacturing machinery, we will suppose that he has also purchased the best apparatus for making steam; and as he has skilled operatives in charge of the machines of the mill, he should have the best skill in the boiler room.

No man who has experience in steam will deny that with the best boiler devised and properly equipped with the appliances for the most economical use of coal, the man with the shovel can, without any change in the outward conditions, except perhaps in handling the damper, increase the daily fuel bill 10, 15 and perhaps 20 per cent., and probably, if he is the kind of man usually found at the boiler, he will have no idea how it was done.

In illustrating my ideas, which I presume to most steam users, as well as to most firemen, will be rather peculiar, I will suppose that we are starting in with a new modern steam plant, the boiler room equipped for weighing coal and water, with such instruments for testing draught, gases, temperature, steam, etc., as are necessary for getting at the actual work. The boilers were put in under guaranty, and have been tested with selected coal by an expert fireman, and have met the conditions. The grate surface, draught, combustion and firing all combine to give the test very satisfactory results. The coal was said to have about 14,000 heat units, the ashes showed about eight per cent., there was no clinker, and everything was quite ideal. In estimating the cost of running the boilers, the owner (who hasn't yet learned all about coal) thinks that a lower priced coal will do him as well as the test coal, and the enterprising salesman meets his views and tells him that *his* coal is what he wants; it has 14,020 heat units, about eight per cent. ash and low in moisture. The owner is referred to users of this coal, who do not use the scales, and they give it a good name, so this coal will be used with the expectation that it will show results similar to those with the test coal, and as the cost is perhaps 50 cents per ton less, there is satisfaction in the office. Our fireman comes with a good record for general efficiency, knowing as much as the average fireman, and takes possession of the boiler room and the coal pile. He has helped in making evaporative tests, can calculate results, and feels equal to the occasion (but *he* hasn't learned all about coal yet). He fires up his boilers, gets steam up to the required point and tells the engineer he is ready for business. He carefully watches the whole outfit for a few days, and then concludes that he will make an evaporative test and see how the coal is doing. In the trial test he learns that the evaporation was nearly 11 pounds per pound of combustible from and at 212° F., and he will be surprised if he does not come pretty well up to it. In his test he is a little more careful about breaking his coal, and also fires more frequently, and is careful to spread the coal evenly. He has noticed that somehow his coal does not coke and furnish a good bed of coals on the grates like the coal he has used; in fact, he saw that when the coal was burned there was nothing left on the grate but light white ashes, but there was a fine blaze and it must make a hot fire. The owner is informed of the tests, and spends some time in the boiler room, seeing how the thing is done. After a ten hours' run the fireman, who has kept careful tab on the various items entering into the test, gets the totals and averages together, and proceeds to figure out the results, with the owner for an interested assistant.

After making his calculations and getting the results the figures show, he doesn't call the amount of evaporation out, but carefully goes over his figures again, which prove correct, and then he informs the owner that there must certainly be some mistake somewhere, because he gets only a little over 8 pounds, and yet for the life of him he can't see what is wrong. Neither can the owner. These tests are continued for several days with little, if any, better results, and then a man, who has studied and learned the "true inwardness" of these things, is called in. He is shown the coal and knows of the mine; is shown some of the coal with which the trial or first test was made, and he knows about that also. He then explains that the differences in the constituent ele-

ments of the two coals were such that while they might in chemical analysis show theoretically a similarity in heat units, and an almost equal evaporative power, yet the volatile matter in the lower priced coal was in such large proportion to the fixed carbon, that in combustion a larger percentage of the heat passed away in the unconsumed gas, and the low evaporation was the natural result. He says that if the fireman would experiment on his grate surface, reducing it, perhaps, 33 per cent., he would increase the efficiency of the coal perhaps 15 to 20 per cent.; but it could not be made to do the work of the test coal, as that was strong in fixed carbon and low in volatile matter, burned slowly, covered the grate with a good bed of incandescent coals and gave out its heat slowly, comparatively, but very little of it was wasted.

The information furnished by the expert opened out before both owner and fireman a new field to be explored, and showed to both of them that if they would save in the fuel bill it could only be done by a careful study of the relative values of the various mines and the right treatment of each grade of coal for the best results, and that meant an educated fireman.

I may be charged with drawing on my imagination for this illustration, but I can say that there is a solid foundation for the whole of it, and it is only a slice out of my own experience.

As I have my ideas in regard to the character and dignity of the fireman's position and his relation to the balance sheet, I also have an opinion of some of the facts with which he should be familiar, and perhaps will offer them for consideration in the near future.

Some Recent Tests of Louisville Cement.

[By Mr. Robert S. Ball, in *Engineering News.*]

The inspection and testing of cements as carried on for commercial purposes present some entirely different features from similar work performed in a scientific laboratory or technical school, where experiments are made to determine the exact nature of different brands of cement with a view to establishing correct estimates to assist the practical engineer in drawing up specifications for such material. The conditions under which such work is done are as different as the ends attained. In the former case the inspector has to determine whether certain material furnished from the mills under ordinary running conditions comes up to requirements laid down by the engineer under whom he is acting; in the latter the scientist pursues investigations on isolated samples of the material, the results of which, valuable as they are in themselves, are useless to the engineer as affording testimony of the value of the product turned out by the manufacturer in quantity at any particular time. In short, it is the province of the scientist to lay down rules for the guidance of engineers, and, what is more important, to establish a uniform system of testing applicable to all practical cases. Such can only be done by conducting experiments over a long period and under different conditions, and with all the different brands of material that come under the engineer's notice. The inspector is to be governed by such specifications in selecting the cement as are required by his clients. While such information, valuable to engineers and manufacturers alike, can be obtained by the work of the inspector, there is so little uniformity in the manner of testing as carried on by different men that no accepted standards can be selected from their discordant results, and it is difficult to institute comparisons for this reason. In well organized laboratories for research, however, more uniform results can be obtained, as usually such experiments are carried on with care, and standard methods are employed in the testing.

Particularly noticeable is the absence of uniformity in the methods used in testing what are known as the natural cements. This is mainly due to the varying nature of the material, which allows the inspector more latitude in the selection of methods applicable to any particular case. Portland cement, on the other hand, is more uniform in quality and the testing can be conducted under conditions approaching more closely to standard methods. Portland cement, being the product of two ingredients, chalk and argillaceous clay, mixed in definite proportions, carefully selected and calcined with a degree of uniformity impossible with the natural rock, necessarily is more uniform in quality. The rock from which the natural cement is made varies so much quantitatively in the proportions of its ingredients that it is difficult to calcine it all to the same extent, for even the rock from the same quarry will show such wide variations in its composition that the resulting cement will vary widely in strength. It is therefore very important that we should have uniform methods of testing which will apply to the natural cements, and while much standardizing has been effected for the testing of Portland cement it seems to the writer that much of it is inapplicable to the systematic testing of the natural material. Unlike all other kinds of testing of materials for constructive purposes, in which tests taken under different conditions can be made comparable by deductions gathered from experience, or, as is more often the case, by mathematical analysis, the testing of cement depends so much on small details overlooked by some, and too much importance attached to them by others, that this kind of testing offers but little room at present for reducing results arrived at by different men to a common standard of comparison. For instance, from some tentatives pursued by the writer, the following details in the process of testing affect to a large degree the results, many of which are not considered in the reports of tests which from time to time are published :

1. The time the cement has been allowed to stand after being manufactured, before gauging.

2. The manner of gauging, whether it has been accomplished by hand or machine.

3. The filling of the mold, whether the sample has been struck off on one or both sides.

A prolific cause for the rejection of natural cement is free or unslacked lime in the material which manifests its presence by checking the briquette, thereby reducing the effective area of the cross section and causing a reduction of the tensile strength. It is the opinion of many that in moderate amounts the CaO does not materially impair the value of the cement, especially if the cement be allowed to stand some time before using, thus giving the lime a chance to air slack. If the cement, hot from the buhrs, be gauged immediately, it would be rejected as incompetent if it showed the slightest signs of checking, while if allowed to stand it would pass inspection and be classed as good material. Thus much cement is rejected by the hasty inspector which would be passed by others. If the cement be used for plastering or work of that kind it is imperative that it shall contain no trace of uncombined lime. It is therefore quite important that the time elapsing between manufacture and gauging should be specifically stated in reports of tests. This will only apply to tests on neat briquettes, for unless the lime be present in very large quantities it will not show its presence in the usual manner in briquettes mixed up with sand. It is the writer's opinion that from this cause tests on natural cement made with sand briquettes are unreliable, for it is impossible to discriminate between inherent bad qualities in the cement and apparent lack of strength caused by the lime which in time would slack out and leave a reliable article.

Referring to No. 2. In laboratories where much testing is carried on, it is found necessary to use machines for mixing, as by the aid of such it is possible to perform four or five times as much work in a given time as could be accomplished by hand. The results, however obtained are not the same. In the first place it is not easy to adjust the amount of water correctly for mixing with the machine, while with the hand sufficient can be added to bring the mass to the proper consistency. Even with different samples of the same cement the requisite amount necessary to enable the proper consistency to be reached will vary with the time the cement has been allowed to stand after manufacture. While the machine has the great advantage of rapidity, more accurate work can be done by the hand of an experienced person. The foregoing relates to tests made with neat samples, as machine made briquettes of sand and cement are entirely unsatisfactory, for the two components do not become thoroughly mixed in the machine on account of their difference in density. For commercial testing on a large scale machine mixers are almost a necessity, due to their increased rapidity, but for accurate scientific tests the spatula, handled by an experienced man, is by far the more reliable. In fact, for comparative tests machine mixed samples are not at all trustworthy, and the element of the personal equation, incident to work performed by hand, introduces less variation into the results than the many defects of the different machines at present in use.

Referring to No. 3. The effect of this detail in testing is not as large as in the two preceding cases, but nevertheless it may give rise to errors which will seriously vitiate the results. The briquette made by striking off on one side only is decidedly inferior to that which has been turned and smoothed off on both sides.

In the first case the mold is laid on a glass plate or slab of some nonporous material, filled with the mixture by pressing with a former, smoothed over the top with a spatula and then allowed to set. Even with more than ordinary care the mold is often not completely filled by this method, as air bubbles will become caught at the bottom and further pressing will cause the air to enter the cement, as there is no way by which it can escape. Thus one side of the briquette will be

porous and a low tensile strength will be the result, caused by eccentric loading on the specimen. By turning the briquette over, however, and applying the spatula to the other side, adding a little more cement if necessary to fill out the mold, a uniform density of cross section is ensured, which in some tests made by the writer made a difference of 3.7 per cent. on a series of samples. As these tests were made with more than ordinary care a larger discrepancy can be looked for under usual conditions of working. The following table gives the results of some tests made by the writer on several brands of Louisville cement during the past year:

No.	No. of tests.	Average lbs. per sq. in.	Remarks.
1	4,997	121.7	24 hours in air and 6 days in water.
2	210	120.0	24 hours in air and 5 days in water.
3	40	124.1	24 hours in air and 4 days in water.
4	58	118.0	24 hours in air and 3 days in water.
5	113	116.7	24 hours in air and 2 days in water.
6	840	117.2	24 hours in air and 6 days in water.
7	3,471	68.2	½ hour in air and 24 hours in water.
8	271	72.0	½ hour in air and 24 hours in water.

It will be seen from the table that the larger number of tests were made of seven days' duration. The manner of testing employed for Nos. 1, 2, 3, 4, 5, 8 was as follows: Samples were taken from the mill as the cement was packed, one sample to every two barrels. This was continued throughout the whole year from time to time, so that the resulting average is a fair criterion of the product throughout the year. The cement was allowed to stand 24 hours after manufacture before gauging. The gauging was done by hand, and the briquettes were struck off on one side only, a pressure such that a man could apply directly being used to force the material into the mold. The form of mold used was that adopted by the Am. Soc. C. E., which was laid on a glass plate during the filling. The briquettes were placed in still water until broken, which was done on a hand machine.

A glance at Nos. 1 and 6 shows that a higher result was obtained from hand-made briquettes than from those made by machine, No. 1 being the hand-made samples and No. 6 the machine made. While the number of tests is not the same, they were so well distributed that comparison is quite justifiable. The same can be seen in Nos. 7 and 8, the latter 271 tests, mixed by hand, showing a higher breaking strength than the 3,471 tests of No. 7, which were machine mixed. Except for the different method of mixing, Nos. 6 and 7 were treated the same as all the others; 87 per cent. to 94 per cent. of the cement would pass through a sieve having 2,500 meshes to the square inch.

Natural Gas in 1895.

Mr. Joseph D. Weeks, in his report on the Production of Natural Gas in 1895, to the United States Geological Survey, remarks:

Among the notable features in connection with the production of natural gas in 1895 may be mentioned:

1. The decreasing pressure in all of the natural gas fields of the country. As will be seen by reference to the statements under the reports by States, the rate of decrease in pressure varies greatly in the several States owing to local reasons. In Pennsylvania, for example, this decrease seems to be the greatest, owing to the fact that the gas fields of this State are the oldest and have been the most heavily drawn upon. In Ohio it is the least, the great decline in pressure in this State having taken place some two or three years ago. The shallow well, low pressure fields of this State maintain both pressure and production quite uniformly, and though there is some decline in pressure even in this field, the ratio is small. The decline in pressure in the wells in Indiana is midway between the decline in these two States; but if the statement made by the natural gas inspector of Indiana is true, that when the pressure declines to 200 pounds the wells are usually drowned out by water, the Indiana gas producer will have to contend with a more serious condition of affairs than either the Ohio or Pennsylvania producer.

2. Resulting from the same cause that leads to this decline in pressure—viz., the reduction in the supply of gas stored in the earth's reservoirs, there is a great falling off in production of gas per well. The only way in which the production can be maintained in view of the reduction in supply and decrease in pressure, is to drill more wells. This is resorted to, where possible, in order that the supply may be maintained.

3. As a further result of the decline in pressure and reduction in supply, the life of the wells, or the time during which a well in a given locality will produce gas in commercial quantities, has been very much reduced. How great this reduction has been in some cases will be seen from an inspection of the reports from the various States. In some cases in Western Pennsylvania the average life of a well in a field is but six months; in others, two or three years, though in the latter case with continually decreasing pressure and production.

Value of Natural Gas Consumed in the United States.—The total value of the natural gas consumed in the United States in 1895 was $13,006,650, as compared with $13,954,400 in 1894, and $14,346,250 in 1893. It may be said here that the consumption of natural gas in the United States in 1895, measured in cubic feet, was considerably less than the amount consumed in 1894; yet, notwithstanding the fact that in many cases much higher prices were charged for gas in 1895 than in 1894, the difference in the value of the gas, or the amount received for it in 1895, as compared with 1894, is not so great as the difference in actual consumption in cubic feet.

In the following table is given the total value of natural gas consumed in the United States from 1893 to 1895 by States:

Value of Natural Gas Consumed in the United States from 1893 to 1895, by States.

Locality.	1893.	1894.	1895.
Pennsylvania	$6,488,000	$6,279,000	$5,852,000
New York	210,000	249,000	241,530
Ohio	1,510,000	1,276,100	1,255,700
West Virginia	123,000	395,000	100,000
Indiana	5,718,000	5,437,000	5,203,200
Illinois	14,000	15,000	7,500
Kentucky	68,500	89,200	98,700
Kansas	50,000	86,600	112,400
Missouri	2,100	4,500	3,500
Arkansas	100	100	100
Texas	50	50	20
Utah	500	500	20,000
Colorado	....	12,000	7,000
California	62,000	60,350	55,000
Elsewhere	100,000	50,000	50,000
Total	$14,346,250	$13,954,400	$13,006,750

In the following table is given a statement of the value of the natural gas consumed in the United States from 1882 to 1895, inclusive:

Total Value of Natural Gas Consumed in the United States from 1882 to 1895.

Years.	Total Value.	Years.	Total Value.
1882	$215,000	1889	$21,107,099
1883	475,000	1890	18,792,725
1884	1,460,000	1891	15,500,084
1885	4,857,200	1892	14,800,714
1886	10,012,000	1893	14,346,250
1887	15,817,500	1894	13,954,400
1888	22,629,875	1895	13,006,650

The Coal Production of the United States, 1895.

Mr. E. W. Parker, of the Geological Survey, has prepared the annexed statement respecting the coal output of the United States during 1895, and he thus summarizes it:

The total production of bituminous coal in 1895, compared with that of 1894 shows a gain of 22,286,264 tons, and the total value shows an increase of $11,609,979. A comparison of the average price during the two years shows how values went down in 1895. In 1894 the average price was $1.09 per ton, but the average during 1895 was 86 cents. And although there was quite an increase in the production, the average number of employees was smaller in 1895 than in 1894, for while the average number in 1894 was 376,206, the number in 1895 was 200,182. In 1894 there were 12,836,373 bushels of coal made into coke, but the amount reported for 1895 was 6,047,824 tons larger.

The average number of days in which the miners worked in 1894 was 178, but the figures reported for last year were 196.

As in the year previous, Pennsylvania continues to lead in production, with Illinois second, Ohio third and West Virginia fourth. The only States showing decreased production during the past year are West Virginia, Kansas and Wyoming, all the others having higher figures. West Virginia's product last year compared with that of the year previous fell away 239,796 tons; Kansas dropped 461,381 tons, and Wyoming 170,552 tons.

Coal Product of the United States in 1895, by States.

States.	Number of Mines.	Loaded at Mines for Shipment.	Sold to Local Trade and Used by Employees.	Used at Mines for Steam and Heat	Made into Coke.	Total Production.	Total Value.	Average Price per Ton.	Number of Days Active.	Average Number of Employees.
		Short Tons.	Short Tons.	Short Tons.	Short Tons.	Short Tons.				
Alabama	60	3,610,444	272,551	137.021	1,673,770	5,693,775	$5,126,822	$0.90	244	10,346
Arkansas	13	576,112	14,935	7,275	.....	598,322	751,156	1.25	176	1,218
California	5	60,440	12,171	2,842	.....	75,453	175,778	2.33	262	190
Colorado	87	2,445,578	49,088	99,055	489,261	3,082,982	3,675,185	1.20	182	6,125
Georgia	2	135,692	150	6,256	118,900	260,998	215,863	.83	312	848
Illinois	...	14,456,524	2,684,607	591,133	3,600	17,735,864	14,239,157	.80	.....	.....
Indiana	113	3,488,876	392,423	104,695	9,898	3,995,892	3,642,623	.91	189	8,530
Indian Territory	16	1,173,399	3,070	21,935	12,781	1,211,185	1,737,254	1.43	164	3,212
Iowa	177	3,630,867	460,820	64,387	.....	4,156,074	4,982,102	1.20	189	10,066
Kansas	106	2,587,602	279,739	59,142	387	2,926,870	3,481,981	1.20	159	7,482
Kentucky	120	3,012,610	254,028	50,294	40,838	3,357,770	2,890,247	.86	146	7,866
Maryland	23	3,840,991	59,950	14,644	.....	3,915,585	3,160,592	.81	248	3,912
Michigan	9	80,403	27,019	4,900	.....	112,322	180,016	1.60	186	320
Missouri	122	2,104,452	231,090	36,851	.....	2,372,393	2,651,612	1.12	163	6,299
Montana	22	924,862	19,168	20,463	539 700	1,504,193	2,850,906	1.89	223	2,184
New Mexico	22	695,634	13,045	11,292	683	720,654	1,072,520	1.49	190	1,383
North Carolina	3	23,400	600	900	.....	24,900	41,350	1.66	226	61
North & South Dakota	9	35,380	3,817	.....	.....	39,197	42,046	1.07	139	65
Ohio	407	11,933,686	1,227,224	152,277	42,619	13,355,806	10,618,477	.79	176	24,644
Oregon	5	68,108	5,294	283	.....	73,685	247,901	3.36	69	414
Pennsylvania	588	35,074,453	1,733,303	468,141	12,851,591	50.127,488	35,932,857	.72	206	70,380
Tennessee	44	1,808,056	51,923	25,477	650,188	2,535,644	2,349,032	.93	224	5,120
Texas	14	475,157	7,705	2,907	.....	484,959	913,138	1.88	171	1,642
Utah	14	376,459	25,097	7,253	63,027	471,836	617,349	1.31	203	670
Virginia	22	1,024,200	15,173	22,338	306,613	1,368,324	869,873	.63	225	2,158
Washington	22	1,108,868	16,320	43,249	22,973	1,191,410	2,577,958	2.16	224	2,840
West Virginia	186	8,858,256	445,023	50,595	2,034,087	11,387,961	7,710,575	.68	195	19,159
Wyoming	25	2,106,937	35,628	81,065	23,281	2,246,911	2,977,901	1.33	184	3,449
Total	2,236	105,717,435	8,340,961	2,085,860	18,884,197	135,028,453	$115,732,271	$0.86	196	200,182
Penna. anthracite						57,999,337	$82,019,272			
Grand total						193,027,790	$197,751,543			

Some of the States show a largely increased production. Alabama's product increased from 4,397,178 tons in 1894 to 5,693,775 tons in 1895. Illinois shows an increase of 3,786,954 tons last year. The Ohio production increased 1,445,950 tons in 1895 compared with the figures of the year previous. Pennsylvania shows the greatest increase, as it amounts to 10,215,025 tons.

Compressed Air Motors in France.

A line on the Popp-Conti system is to be opened in St. Quintin, France, in the Department of the Aisne, in which the inventors have sought to create an intermediary system which would obviate the two principal objections, the carrying of a large amount of dead weight and the loss of time in taking cars to the charging stations. To do this it was necessary to provide on the line of rails over which the cars travel, a series of stopping places at short intervals, corresponding to the stations where passengers enter and leave the vehicles. It was desirable that while this necessary stop was being made communication should be automatically made between the reservoirs on the car and the air mains placed beneath the track. As the pressure of air in the main, delivered from the central station, located at a point more or less removed, was comparatively low, and as it was necessary to retain in the reservoirs on the car a sufficient amount of compressed air to carry a car over two sections of the line in the event of one section being out of order, it was evident that the reservoirs must be relatively large and the charging stations close together. In the St. Quentin installation the central station is equipped with three 100-horse power compressors. The central station under this system does not have to labor under the disadvantage of having to provide an irregular amount of power, or rather the irregularities occur at fixed intervals and within well known limits. The distributing mains comprise pipes varying from 1.6 to 4 inches in diameter, and as the rails comprise a number of lines diverging from one common point, a few circular lines of air mains are found to supply the different air junctions desired, with a total length less than that of the tracks. By the use of the looped system of mains, it is possible to isolate any section of pipe for repairs, by means of valves, while the rest of the system is kept under pressure. At each station where the car customarily stops, there is placed between the rails and on the level of the roadway a jointed plate, which under certain conditions opens freely in the center. The passage of the first pair of wheels over the rails causes the plate which covers a brick pit to open. From the pit rises a flattened pipe, which is in communication with the air main, and is joined to a pump barrel. The whole governing of the junction arrangements between the air main and the mouth of the receiver on the car is under control of an ingenious device intended to be operated only by the vehicle which it is intended to serve.

The first and second pairs of wheels operate, as stated, upon a pedal. This is placed in a section of special rail between two ordinary rails and immediately adjoining the plate. The pedal is operated by the flanges of the car whee's, and is so held up by means of a coiled spring as not to be operated except under a considerable weight. Thus the narrow wheels of a light vehicle may enter the grooves of the rail and pass over the pedal, which would remain unaffected by its relatively light pressure, while a heavy truck of weight approaching that of the street car will necessarily have a wheel too broad to enter the groove of the rail, and therefore could not touch the pedal. The second pair of wheels passing over the pedal reverse the operation, sever the air connection and return the junction mechanism to its place in the pit beneath the street level. There are a number of ingenious details attaching to the junction of the feed connection with the car storage reservoirs. The charging of a car with the requisite energy is stated to occupy only 15 seconds. The motor is placed under the middle of the car and is accessible from the interior. It is a compound engine with variable expansion, and according to the power required it can be worked with double expansion or by full admission of air into the cylinder. The Popp-Conti system comprehends the double heating of the compressed air before it is admitted into the cylinders. This is accomplished by means of a coke fire, which is fed automatically. The motor may be driven from either end of the car by means of three small valves placed conveniently for the driver. The first of these operates the links, the only function of which is to change the direction of the engine. The admission of air into the small cylinder is regulated by means of valve gear, which is controlled direct by the driver, and the same hand wheel which governs the full range of power of the engine also serves in its altered position to apply the maximum retarding power of the brakes.

THE authorities of North Adams, Mass., have awarded a contract for the public lighting of that place to the North Adams Gas Light Company, the agreement to run for two years. Under the contract the company is to receive 27½ cents per night for each arc lamp, $24 each per year for gas lamps, and oil lamps, in the suburbs, at $13 each per year.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR S. S. STRATTON writes us that he has connected himself with the Electric Gas Stove Company, of Detroit, Mich.

A LARGE coke and bye-product plant on the Otto-Hoffman plan is being erected at Glassport, near Pittsburgh, Pa., the site of which is on a strip of land lying along the Monongahela river. Of course it will be well located for the bringing in of Fourth Pool Youghiogheny coal by water. The plant will at first consist of 120 ovens, though the purport of the proprietors is to greatly increase this in the future. The first construction will have a capacity of 170,000 tons of coke per annum, and the surplus of gas will be about three million cubic feet per day. Tar and sulphate of ammonia will also be produced in large quantities. A 60-oven plant is already in operation for the works of the Cambria Iron Company, at Johnstown, Pa., to which we understand another section of the same size is about to be added. The exclusive rights of this process for the United States and Canada are owned by the United Coke and Gas Company, the main offices of which corporation are in the Bourse Building, Philadelphia. The Company also has a branch office at Pittsburgh, which has chiefly to do with questions of practical construction. It is asserted that the only local rights so far disposed of are given in the two cases above named, and the officers of the Company are the only ones authorized to take up the question of disposition of rights.

THE following letter is self-explanatory:

LA CROSSE, WIS., July 8, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: The statement regarding temperature of gas at meter and holder made by our honored friend, Mr. George Light, is such as would be expected from one as careful and methodical as he. No member of the gas fraternity would look for him to allow a variation of 45° in temperature of gas *anywhere* in his works after passing condensers and scrubbers. His views as to temperature of water in tanks varying with number of steam jets used are naturally correct. Reference to my statement of experience in this line will show that the variations I mentioned were in tanks *I had tested*, but were not given as arbitrary figures.

Respectfully, T. A. BATES.

THE proprietors of the Town of Hempstead Gas and Electric Light Company, which Company has the franchise for distributing gas in the village of Far Rockaway and the adjoining districts, are quite well pleased over the success which has thus far attended their enterprise. The gas is of good quality, and the summer residents of this fancied seaside resort are not slow in expressing their approval of the business-like way in which the affairs of the Company are conducted. The officers of the Company are: Directors, W. Mealy (Hagerstown, Md.), Henry Steck (Philadelphia), E. B. Knight, Charles Schilling and Thomas Henderson, of Far Rockaway; President, W. Mealy; Secretary and Treasurer, Henry Steck; Superintendent, G. B. Knight.

AT the annual meeting of the shareholders of the Coshocton (Ohio) Light, Fuel and Power Company the officers chosen were: Directors, Houston Hay, Andrew Hartman, George A. Hay, J. C. Fisher and George B. Edgar; President, Houston Hay; Vice-President, J. C. Fisher; Secretary and Treasurer, Geo. B. Edgar. It was also decided to change the time of the annual meeting to the first Monday in June.

AT a recent meeting of the Board of Directors of the reorganized Rome (N. Y.) Gas Light Company Superintendent J. D. Higgins handed in his resignation, and Mr. Stephen Parrish was named to succeed him.

LAST week we said that the Consumers' Gas Company, of Toronto, had no immediate intention or purpose of reducing the selling rate, but before that issue of the JOURNAL was in the mails we were in receipt of a copy of the Toronto *Globe*, at hand too late, however, to make a correction of what had been written. The official announcement of the Company's action, as per the advertisement in the *Globe*, is appended: "The judgment in the Court of Appeals, in the suit of Johnston *v.* The Consumers' Gas Company, having been given in the Company's favor, the Directors consider themselves at liberty to make a material reduction in the price of gas. They have accordingly decided to reduce the net price of gas, on and after 1st July next, to 90 cents per 1,000 cubic feet, to all consumers (when accounts are paid within the specified time), whilst the gross price will be reduced from $1.50 to $1.20 per 1,000 cubic feet. The above net price is lower than that charged by any gas company in America not more favorably situated as regards prices of material used. By order of the Board, W. H. PEARSON, Gen. Manager and Secretary."

THE *Globe* also had this to say respecting the action taken by the Company: "The action of the Consumers Gas Company in reducing the price of gas to 90 cents per 1,000 cubic feet in place of $1 and $1.05, as previously, will be hailed with pleasure by citizens generally. In conversation with a *Globe* representative yesterday afternoon (July 6), Mr. Pearson, the Company's Manager, remarked that the Directors had only waited until the decision of the courts in the recent lawsuits was made known before making public their intention. The result of the litigation had been favorable to the Company at all points, for the sum and substance of it was to declare that the Company had absolute power to make their own terms. They could charge what they liked, serve whom they liked, and refuse to serve anyone they wished. They had always desired to give the public the best possible terms, and now that pressure had been removed they showed this by a voluntary reduction to the lowest price possible. Gas in Toronto was now lower than in any city on the Continent, save two or three, where the cost of material was much less than here. Mr. Pearson was satisfied there would now be an end to all troublous and expensive litigation, and the citizens would extend to them that fair treatment and consideration which he scarcely thought they had received in the past."

AT the annual meeting of the Haverhill (Mass.) Gas Light Company the following officers were elected: Directors, A. A. Sargent, U. A. Killam, G. C. Clement and W. H. Moody; Clerk and Treasurer, Wm. H. Curtis.

THE Directors of the Lebanon (Pa.) Gas Company have declared a semi-annual dividend of 4 per cent.

WRITING of Lebanon causes the further mention that a charter has been granted to the Lebanon Fuel, Illuminating and Power Company, the promoters of which have been waiting for the necessary consent for some months. The officers of the concern are: President, Dr. Samuel Weiss; Vice-President, J. F. McGovern; Secretary, Harvey Hauer; Treasurer, Elmer E. Hauer. It is capitalized in $60,000.

THE Philadelphia *Press*, of the 9th inst., contains the following interesting mention: "After hearing the arguments of counsel, Judges Sulzberger and Pennypacker, in Common Pleas Court, No. 2, have dismissed the exceptions taken to the findings of the Referee, W. W. Wister, Jr., in the suit of the Philadelphia Company against the United Gas Improvement Company to recover damages for alleged breach of contract. In October, 1888, the Philadelphia Company agreed to supply gas in its pipes in Pittsburgh as an illuminant, to be used by all consumers who used a certain appliance furnished by the United Gas Improvement Company, and it was agreed that monthly accounts should be rendered of the quantity of gas furnished and the defendant Company should pay a certain price per 1,000 cubic feet, with the provision that not less than $10,000 should be paid for the first year, not less than $20,000 for the second year, and not less than $25,000 for the third year. The Philadelphia Company alleged that it had complied with its part of the agreement, but that defendant Company defaulted in its payments for the first three years to the aggregate amount of $46,520.20, to recover which suit was brought. The United Gas Improvement Company in its defense contended that during the winters the supply of gas furnished by the Philadelphia Company was totally inadequate to meet the demand, and that the pressure was so low that in large factories, mills, etc., where they had introduced their patent device, the light was so poor as to be utterly useless, and that as they had been put to great loss and expense through the inability of the plaintiff Company to supply the necessary quantity of gas, they refused to pay for any more than was actually consumed. The matter was sent before Mr. Wister, as Referee, who rendered a decision in favor of the United Gas Improvement Company. Exceptions were thereupon taken to his findings, but the Court has overruled them and confirmed the Referee's report."

AT the annual meeting of the stockholders of the Cape Island (N. J.) Gas Company the officers chosen were: Directors, E. A. Armstrong, David Baird, J. J. Burleigh, J. Henry Edmunds and J. Willard Morgan; President, E. A. Armstrong; Secretary, John J. Burleigh; Treasurer, David Baird; Superintendent, J. Henry Edmunds. The Company will make some alterations to the plant.

MR. W. H. SWINDELL has been appointed Superintendent of Lamps and Inspector and Sealer of Gas Meters for the city of Baltimore, Md.

THE following is the result of the annual election of the shareholders in the Burlington (Vt.) Gas Light Company: Directors, B. B. Smalley, A. G. Pierce, U. A. Woodbury, J. S. Pierson, F. H. Wells, R. G. Leverson and F. H. Parker; President, B. B. Smalley; Vice-President, A. G. Pierce; Treasurer, Clerk and Superintendent, F. H. Parker.

THE Citizens Fuel Gas Company, of Bridgeport, Conn., is ready to supply gas.

THE following is the full text of the communication presented to the Board of Public Works, of Kansas City, Mo., by Colonel Payne, President of the Kansas City Gas Company, in reply to the claims made of superiority of the gas furnished by the Missouri Gas Company, of the same city: "Any representation made here or elsewhere, that the gas sold in this city at $1 per 1,000 is better and more economical than that furnished by the Kansas City Gas Company at 50 cents per 1,000 is preposterous and a willful misrepresentation of fact. Each of the charters of the two Gas Companies in this city requires gas of not less than 22-candle power. The Kansas City Company furnishes gas at a higher standard than 22 candles, as can be proven by reliable tests made in the usual way. Whether or not the other Company makes as good I do not know, but I presume that it complies with the law. An official inspection only, which we invite and urge, can determine that question. No ex parte statement or showing of results by private methods should receive the stamp of your approval or that of the Gas Committee be cause it is not reliable. The city of right may elect to pay $1 per 1,000 for gas if it chooses to do so, when it can get just as good, if not better gas, for 50 cents per 1,000; but I protest that it is unfair and unjust to do so on the basis which prompted the action of this Board. The only legitimate and reliable test of gas can come from official inspection, and it therefore behooves the city to appoint an inspector of gas and gas meters. The people who use gas are entitled to proof that they are getting gas of 22-candle power; they are entitled to the further proof that the meters used to measure the quantity of gas taken by them are reliable registers of the gas which has been delivered. To accomplish this purpose—to assure the people they are not imposed upon by either Company in the quality of gas and its measurement—it is the duty of the city to furnish official inspection as the gas charters provide be done. We do not stop at inviting that this may be done, but we urge it with the utmost earnestness as a duty which the city owes the people. But, if this test of gas must be made at a fire engine house, let it be an honest one and under the supervision of this Board, or someone designated by it to keep 'tab.' Give the Company making this claim of cheaper gas 15 days' trial or a months' trial, if you please, and after that give the old Company a trial for a like time and under precisely the same conditions—burners the same, hours of burning the same; the meters to remain in the custody of this Board until the tests are made, and then be sent to Chicago or St. Louis for test of their accuracy, thus guarding against the possibility of a slow meter being utilized in the test by either Company. If it can be shown that the new Company's claim that its gas is cheaper at $1 per 1,000 than the Kansas City Company's at 50 cents, we will donate to the city $1,000 for charity; if it has been found that it is as cheap at 75 cents per 1,000, we will donate $500 to the city for charity; and if it is proved to be as cheap at 60 cents per 1,000, we will donate $250 to the city for charity. We confidently assert that ours is the cheaper gas."

THE Finance Committee of the City Council of Athens, Ga., has placed the valuation of the property of the Athens Gas Light Company, for purposes of taxation, at $12,000.

THE rate for fuel gas supplied in St. Louis, Mo., by the Laclede Gas Company, is 80 cents per 1,000 cubic feet. The schedule went into effect on the 1st inst.

A CORRESPONDENT at Scranton, Pa., informs us that some days ago Judge L. H. Bennett, of the Luzerne county bench, Master in the equity suit of the Scranton Gas and Water Company against the Northern Coal and Iron Company, filed a report in favor of the defendant in Prothonotary Pryor's office. The Scranton Gas and Water Company claimed a plot of ground on Scranton street where a part of the gas plant now stands, by virtue of a right under its charter. For some time past the defendant Company has been unable to lay a double track at this juncture on account of the opposition of the Gas and Water Company. The Railroad Company, under its charter, was allowed to take a right of way 30 feet wide, but only 15 feet were taken when the single track was laid in 1871. Judge Bennett decides now that the Railroad Company can take the remaining 15 feet of right of way, the same as was granted in its charter. The Delaware and Hudson Company is now operating the line of the defendant Company.

EARLY this month official notification of the leasing of the Union (natural) Gas Company, of McKeesport, Pa., to the Emmett Queen Company, was given out. In the statement this explanation of the advanced gas rate is made: "The cost of securing this [a supply of natural gas from the West Virginia field] is such as to compel us to charge the same rates as Pittsburg, Braddock and other places, for gas used after July 1, 1896, viz.: 25 cents per 1,000 cubic feet, with 10 per cent. discount on each month's bill, if paid by the 10th day of the month following." The rate of the Union Company has been 15 cents per 1,000 cubic feet. The 6 inch mains of McKeesport have been attached at right angles with the Carnegie mains from West Virginia on the Smith farm in Versailles township. It is possible that by next spring the Otto Coke, Gas and Chemical Company, of Glassport, will also be distributing fuel gas at McKeesport.

PRESS despatches are to the effect that the plant of the Oxy-Hydrogen Gas Company, of Wilmington, Del., will not be sold at auction just yet, on account of the refusal of its owner (Mr. J. E. Addicks) to pay taxes thereon. Tax Collector Eugene Sayers and City Solicitor Hartman, representing the municipality, and H. H. Ward, representing the Company, have come to an understanding whereby the present proceedings will be dropped, and the question will come up before the Superior Court at the September term. The question involved is whether the city can collect tax upon property which it prevents from being put to the use for which it was designed.

THE proprietors of the Bridgeport (Conn.) Gas Company will shortly announce a decided concession in the selling rates, a move consequent upon the starting up of the plant of the Citizens Fuel Gas Company of that city.

THE Board of Managers of the Ohio State Penitentiary recently awarded a contract to the S. E. Barrett Mfg. Company for the tar produced on the gas works from which the prison buildings are illuminated. Local parties (the prisons are located in Columbus) protested against the award of the contract, alleging that no advertisement for bids had been published as required by statute. The award is likely to be brought before the courts for review.

THE residents of the district in St. Louis that was swept by the recent tornado are much put out by the delay in re establishing the electric lighting service, although the simple truth is the electricians are doing the very best that it is possible to accomplish under the circumstances. The residents, however, appealed to the authorities for relief, and the City Lighting Bureau, after looking over the means at command for the speedy lighting of the affected district, instructed Mr. A. J. O'Reilly, Supervisor of City Lighting, to communicate with the Laclede Gas Light Company for a bid to illuminate that section of the city with gas until the electric lights were replaced. In reponse to the communication, General Manager Ross, of the Laclede Company, submitted the following: "We can replace the gas lamps in the district mentioned, at the rate of about 100 per day, commencing within two weeks after receipt of order. As a large number of lamps have been disconnected and will require new services, we make the following propositions: To connect service, furnish lantern, cock and burner, $6.50 each. Where service is in good condition, to furnish lantern, cock and burner, ready for lighting, $4 each. The total cost for 2,000 lamps will be about $10,000. New lanterns will be furnished throughout, as our stock of lanterns and the building containing them were destroyed by the cyclone. The above proposition is with the understanding that the lanterns and cocks remain the property of the Company after the lighting is discontinued. For furnishing gas, per city schedule for electric lighting, lighting, extinguishing, cleaning and keeping in repair, 10 cents per lamp per diem."

UNDER the new schedule for the public gas lighting of Washington, D. C., it is specified that the hours in which the lamps shall be lighted may not be less than 3,760 per annum; that the time of burning shall be from 45 minutes before sunset until 45 after sunrise; and that the time required for lighting and extinguishing shall be considered as not included in the 3,760 hours.

THE plans for the new power house for the Amherst (Mass.) Gas Company were prepared by Messrs. Putnam & Bailey, of Northampton, Mass.

"INQUIRER" is informed that the officers of the Inter-State Gas Company, of Ohio, are: President, James Kerlin; Vice-President, C. M. Kerlin; Secretary, C. H. Lemmon; General Manager, R. G. Kerlin.

THE projectors of the Queen City Gas Company, of Buffalo, N. Y., say that they intend to supply a gas of 25-candle power, at a rate therefor not to exceed 80 cents per 1,000 cubic feet. Perhaps so!

MR. CHARLES E. BULLARD has been appointed Plumbing Inspector for Malden, Mass.

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MONDAY, JULY 20, 1896.

The Spontaneous Ignition of Coal.

Professor Medem, in *Kuhlow's Trade Review*, traces spontaneous ignition to the oxidation of iron pyrites, and as no coal is entirely free from this sulphide of iron, the cases the doctor brings under notice become all the more interesting.

In the course of a treatise on the spontaneous combustion of hay and coal, he gives the following account of the causes of this phenomenon and methods that have been proposed for its prevention and suppression.

The simplest form of spontaneous ignition is exhibited by dry, spongy platinum, and is due to the absorption and condensation of oxygen in the pores of the metal. When exposed to a current of hydrogen gas, chemical combination immediately sets in, raising the temperature sufficiently to ignite the stream of hydrogen.

In the case of charcoal, a pyrophoric tendency is only manifested when some of the volatile hydrocarbons have been left behind in the distillation process and enter into combination with absorbed oxygen. If, however, such charcoal be freely exposed to air, the external portions speedily lose this property, owing to the pores becoming saturated with air, but it will regain its pyrophoric character if powdered so that the internal layers are enabled to absorb oxygen. As the process of chemical combination only goes on in the interior of a heap, the best way to arrest it is to spread the charcoal out, since attempts at ventilation by blowing or drawing air through the mass will only result in increasing the combustion. Every time the charcoal is broken up the danger of ignition will recur, down to the time it is ground to powder, but powdered charcoal once "killed" by exposure to air never regains its pyrophoric properties.

Hard coals, brown coals and the like are subject to two dangers, explosion and ignition, each having a separate cause. Explosion is due to the liberation of firedamp following on a decrease in atmospheric pressure, whereas ignition results from the oxidation of the iron pyrites contained in the coal, when exposed to the action of oxygen and moisture. The danger is the greater the finer the state of division of the coal, and coal stacked above ground is particularly liable. Attempts made to reduce the danger by ventilating the stacks have failed in this case also, on account of the increased amount of oxygen thereby introduced into the interior of the mass, and accordingly the coal is stacked as tightly as possible in order to exclude air. Strangely enough, the practice of ventilating the coal bunkers of ships has not been altogether abandoned, notwithstanding Liebig's impressive warning given as far back as 1866, and neglect in this particular has frequently led to lamentable fatalities. Since 1865 no less than 97 coal laden vessels have been destroyed and the lives of some 2,000 seamen sacrificed through spontaneous ignition of the cargo.

A System of Blue Printing.

A writer in the *Practical Engineer* remarks that, in holding tracings over sensitized paper in blue printing, it is a comparatively easy matter to obtain a good contact between a small negative on glass and the paper, but it is not so easy to deal with several square feet of tracing cloth and a corresponding area of sensitized paper. Notwithstanding this, the general tendency is to adopt large sheets of plate glass fitted into heavy wooden frames. A piece of thick felt is pressed against the paper by means of a flexible board, acted upon by some simple form of spring. This apparatus produces a good contact and sharp definition when carefully handled, but at the best it is clumsy, and the glass plate is always liable to fracture.

An improvement in this frame, and one which obviates the use of springs, is the addition of a rubber bag, which can be inflated after the tracing and photographic paper are in position, thus bringing them into close contact with the glass. This, however, adds to the first cost, and does not enhance the durability of the arrangement. With the not too careful usage of the office boy, the rubber deteriorates, and usually announces the fact by allowing the air to escape slowly during the process of exposure, thus buckling the tracing and spoiling the photograph. Instances are cited where tracings 10 feet long have been satisfactorily photographed by means of two revolving rollers. The first roller may be about 9 inches in diameter, covered with thick felt and a round of cartridge paper. Having mounted this roller upon a suitable axis, the tracing cloth, together with a continuous length of sensitized paper, is wound tightly upon the cylinder. The free end is attached to the second roller, upon which the cloth and paper are wound as the exposure is completed. With rapid paper, such as is now procurable, and a good sunlight, very good results may be obtained in this way with an exposure of about three minutes. Some simple way of revolving the rollers uniformly will readily suggest itself as suitable.

While this method is suitable for reproducing tracings of unlimited length, it is, of course, quite out of place in the ordinary rontine of drawing office work. An arrangement has been patented in Germany by which the air is exhausted by means of a pump from between a sheet of glass and the tracing cloth, in order to produce close contact, but this method is not favored. There is a simpler and inexpensive way of obtaining good results. Procure a well-flattened piece of ¼ inch iron plate of the required width and length. Cover this with thick felt on one side by means of a cement or special glue. Cut off two stiff boards the same length as the iron plate, and batten them together side by side. The plate may then be laid upon these boards, and the tracing with the sensitized paper clamped to the felt side of the iron plate. Taking hold of the edges of the plate in the middle will cause it to deflect into a circular arc, drawing the creases out of the tracing cloth. Suitable notches cut in the boards to receive the lower edges of the plate will cause the latter to stand as an arch, with the tracing upon its upper surface. If the tracing is well clamped to begin with, a very slight curvature suffices to bring it into good contact with the photographic paper; this being so, the intensity of light all over the surface is fairly uniform. If necessary, the iron may be sprung in the reverse direction, to assist in taking out the creases and reducing the final curvature. Enough has been said to indicate the means of dispensing with expensive frames and large sheets of glass. With minor details conveniently arranged, the method described cannot fail to commend itself to any practical draughtsman.

The Market for Gas Securities.

There is simply no market for gas securities, or for anything else, for that matter, the lack of buying orders giving those who operate on the short side complete swing. Consolidated sold down to 142, but is a trifle firmer to-day (Friday), the opening having been reported at 144½ to 145. Other city gas shares, save in the instance of Mutual, which is firm at 225 bid, are involved in the depression, New York and East River issues being noticeably weak. The Common East River is reported at 29 to 31. All we have to say about the situation is this: There is no real cause for the decline in gas shares, for the New York Gas Companies were never in better condition than they are at present. No matter either whether or not a bimetallic standard is eventually arrived at, the gas companies are sure to get a real dollar in exchange for a dollar's worth of gas. Our advice is to buy anything on the city gas share list at ruling prices. Brooklyn Union has been marked down to 84½ bid; it is easily worth par. Chicago gas is quoted at 54 to 54¼; Bay State is 17 to 18; Laclede is 18½ to 19½, and Baltimore Consolidated is 54 to 54¼.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

JULY 20.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	144½	145
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	190	..
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	225	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	29	31
Preferred	2,000,000	100	..	70
Bonds 1st 5's	3,500,000	1,000	97	100
" 1st Con. 5's	1,500,000	..	85	90

Richmond Co., S. I.	348,650	50	50	..
" Bonds.	100,000	1,000	..	..
Standard	5,000,000	100	73	76
Preferred	5,000,000	100	102	106
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109	112
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	84¾	85
" " Bonds (5's)	15,000,000	1,000	..	105
Bay State	5,000,000	50	17	18
" Income Bonds.	2,000,000	1,000	..	35
Boston United Gas Co.—				
1st Series S. F. Trust.	7,000,000	1,000	77	80
2d " " "	3,000,000	1,000	57	63
Buffalo Mutual	750,000	100	125	..
" Bonds.	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	54	54¼
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers. Jersey City	2,000,000	100	..	78
" Bonds.	600,000	1,000	..	101
Cincinnati G. & C. Co.	7,000,000	100	198¾	200
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	61	62½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds.	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds.	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	..	90
" Bonds.	2,000,000	..	90	95
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	130	136
" Bonds, 6's.	2,650,000	..	103	105
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	..	92½
Bonds	1,000,000	1,000	..	98
Louisville	2,570,000	50	..	
Laclede, St. Louis	7,500,000	100	18½	19½
Preferred.	2,500,000	100	..	82
Bonds	9,034,400	1,000	92½	93
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds.	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage.	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred.	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94½	95
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's.	650,000	..	84	87
Extension, 6's.	600,000	..	..	..
General Mortgage, 5's.	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	60	65
Bonds, 5's	3,556,000	.	87	90
Wilmington, Del.	500,000	5	188	190

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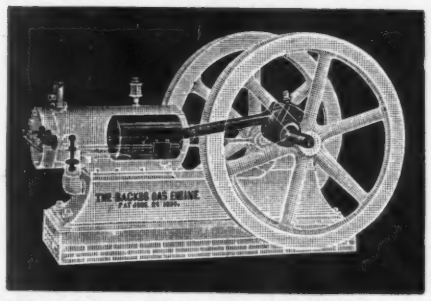

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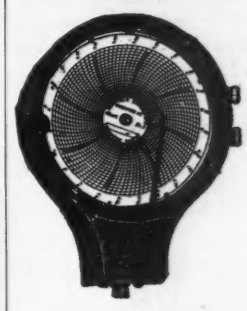

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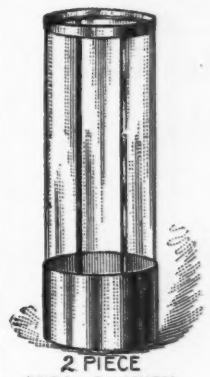

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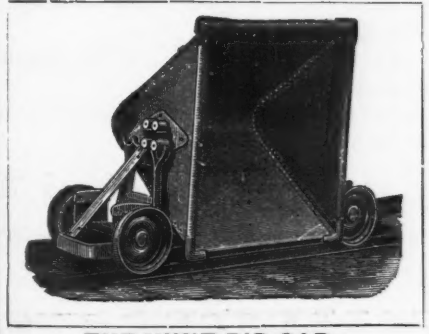

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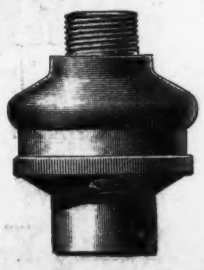

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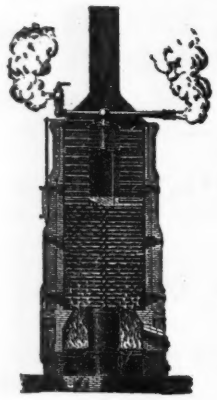

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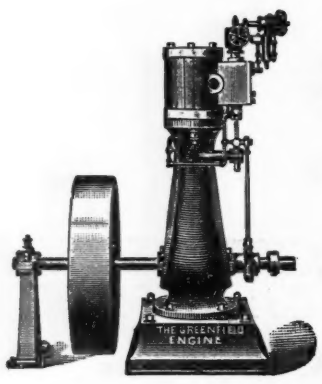

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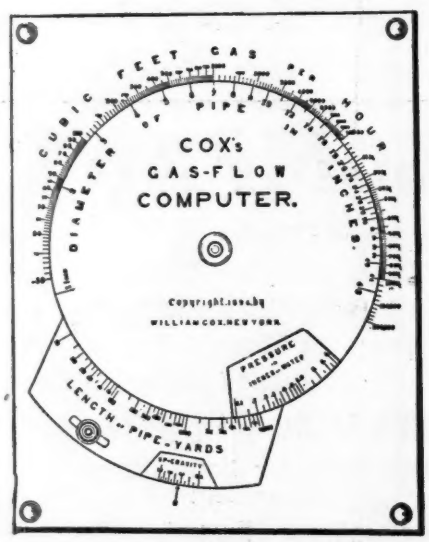

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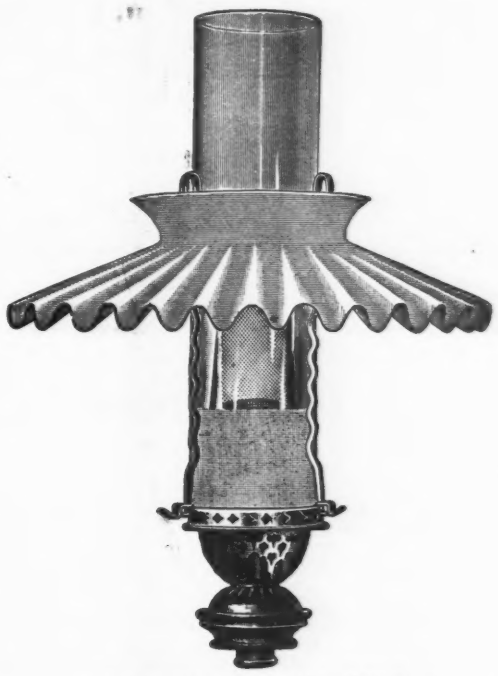

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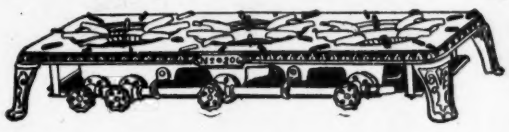

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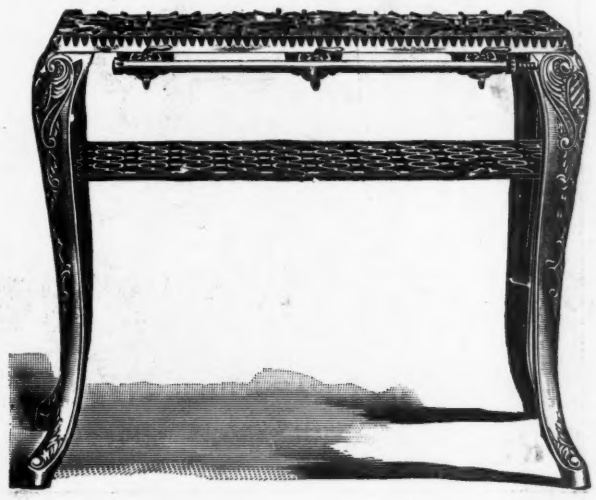

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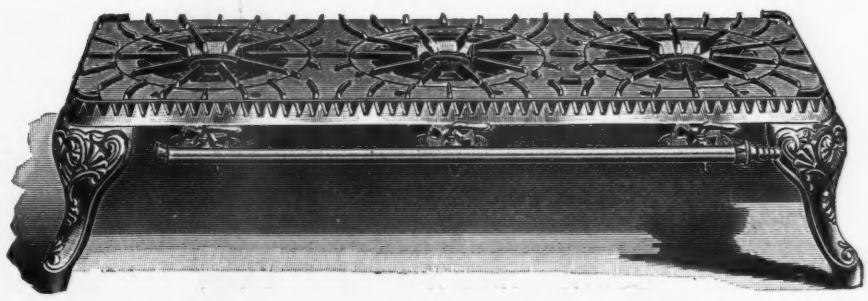

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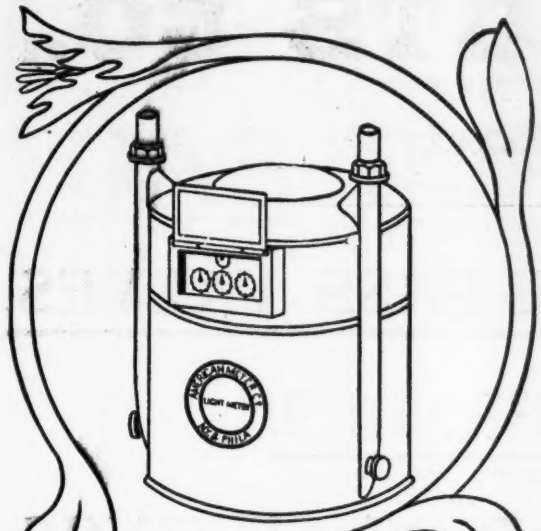

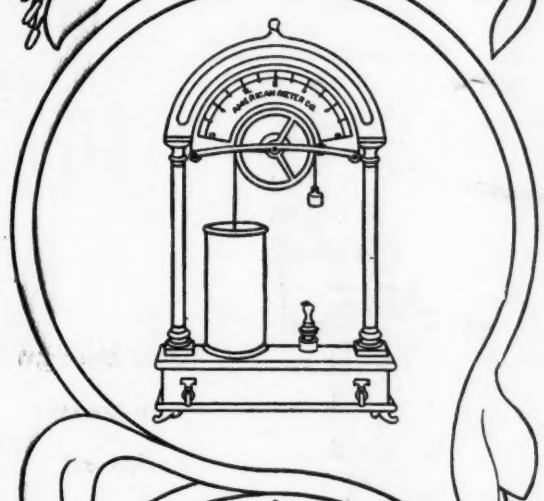

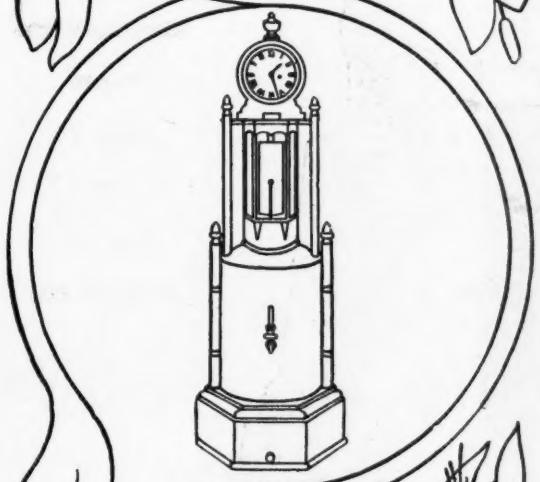

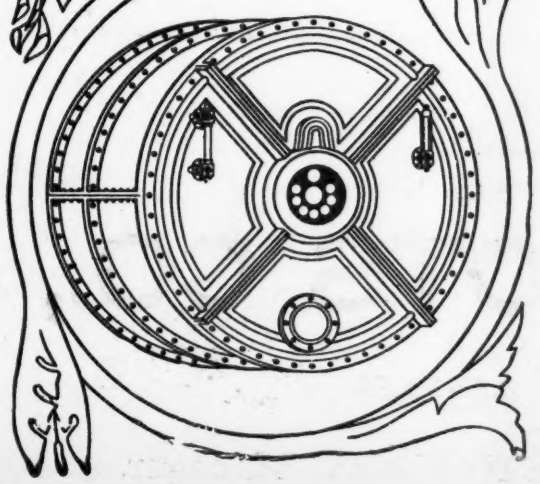

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SAN FRANCISCO.

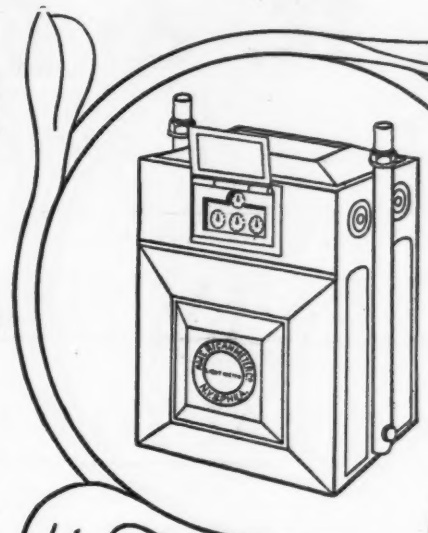
PUBLIC LIGHTING TABLE.

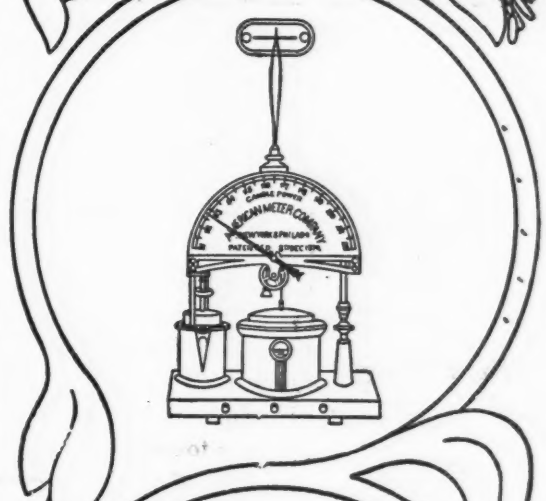
AUGUST, 1896.

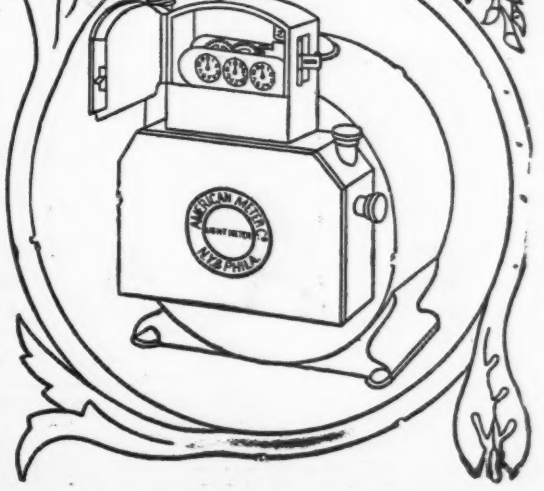
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sat.	1	7.50 PM LQ	11.40 PM	7.10	3.30
Sun.	2	7.40	12.10 AM	7.10	3.30
Mon.	3	7.40	12.50	7.10	3.30
Tue.	4	7.40	1.50	7.10	3.30
Wed.	5	7.40	4.00	7.10	3.30
Thu.	6	7.40	4.00	7.10	3.45
Fri.	7	7.40	4.00	7.10	3.45
Sat.	8	7.40 NM	4.00	7.10	3.45
Sun.	9	7.30	4.10	7.10	3.45
Mon.	10	7.30	4.10	7.10	3.45
Tue.	11	7.30	4.10	7.10	3.45
Wed.	12	7.30	4.10	7.10	3.45
Thu.	13	8.10	4.10	6.55	4.00
Fri.	14	8.40	4.10	6.55	4.00
Sat.	15	9.20 FQ	4.10	6.55	4.00
Sun.	16	10.10	4.20	6.55	4.00
Mon.	17	11.00	4.20	6.55	4.00
Tue.	18	12.10 AM	4.20	6.55	4.00
Wed.	19	1.10	4.20	6.55	4.00
Thu.	20	2.20	4.20	6.45	4.10
Fri.	21	No L.	No L	6.45	4.10
Sat.	22	No L. FM	No L.	6.45	4.10
Sun.	23	No L.	No L.	6.45	4.10
Mon.	24	7.10 PM	8.10 PM	6.45	4.10
Tue.	25	7.10	8.30	6.45	4.10
Wed.	26	7.10	8.50	6.45	4.10
Thu.	27	7.10	9.20	6.30	4.20
Fri.	28	7.10	9.40	6.30	4.20
Sat.	29	7.10	10.10	6.30	4.20
Sun.	30	7.00 LQ	10.50	6.30	4.20
Mon.	31	7.00	11.30	6.30	4.20

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00







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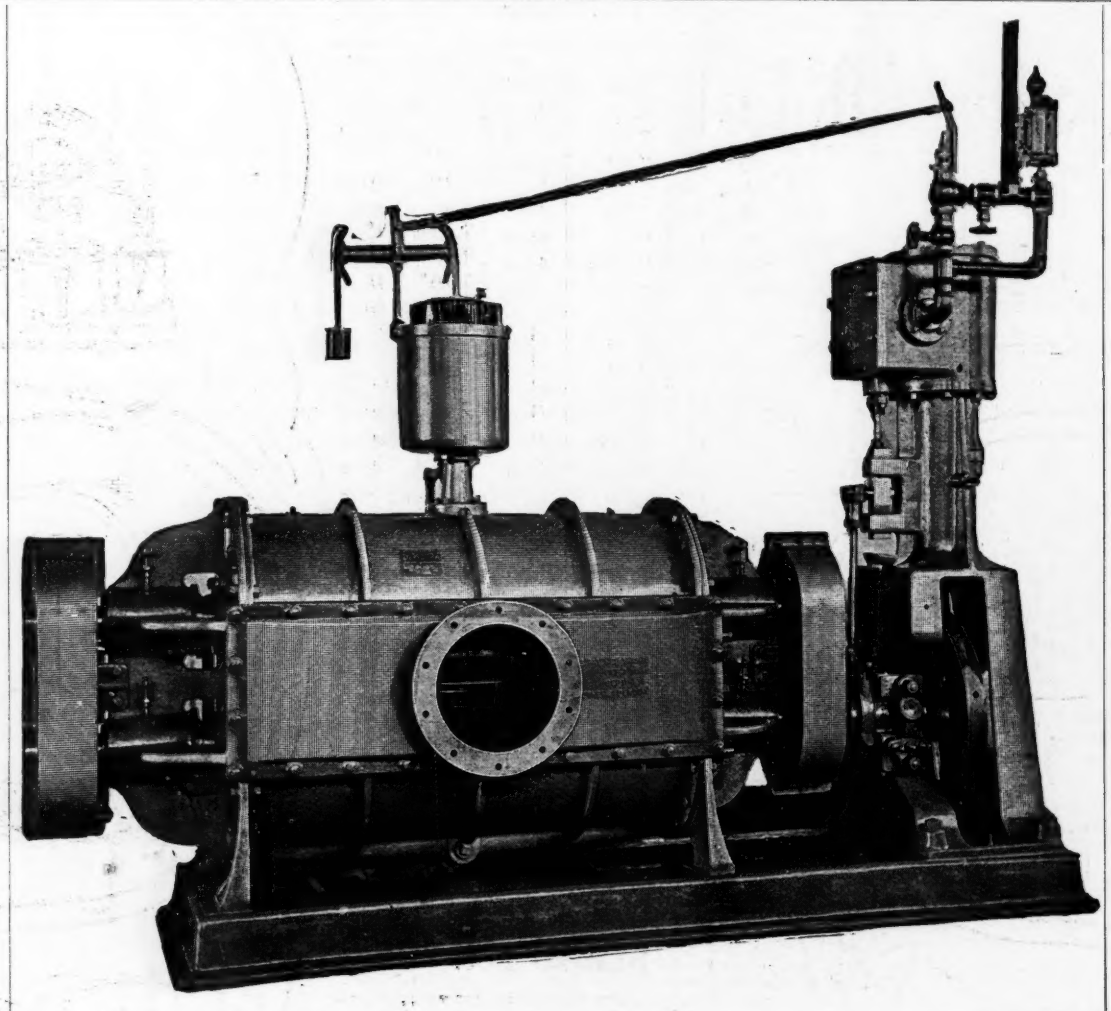

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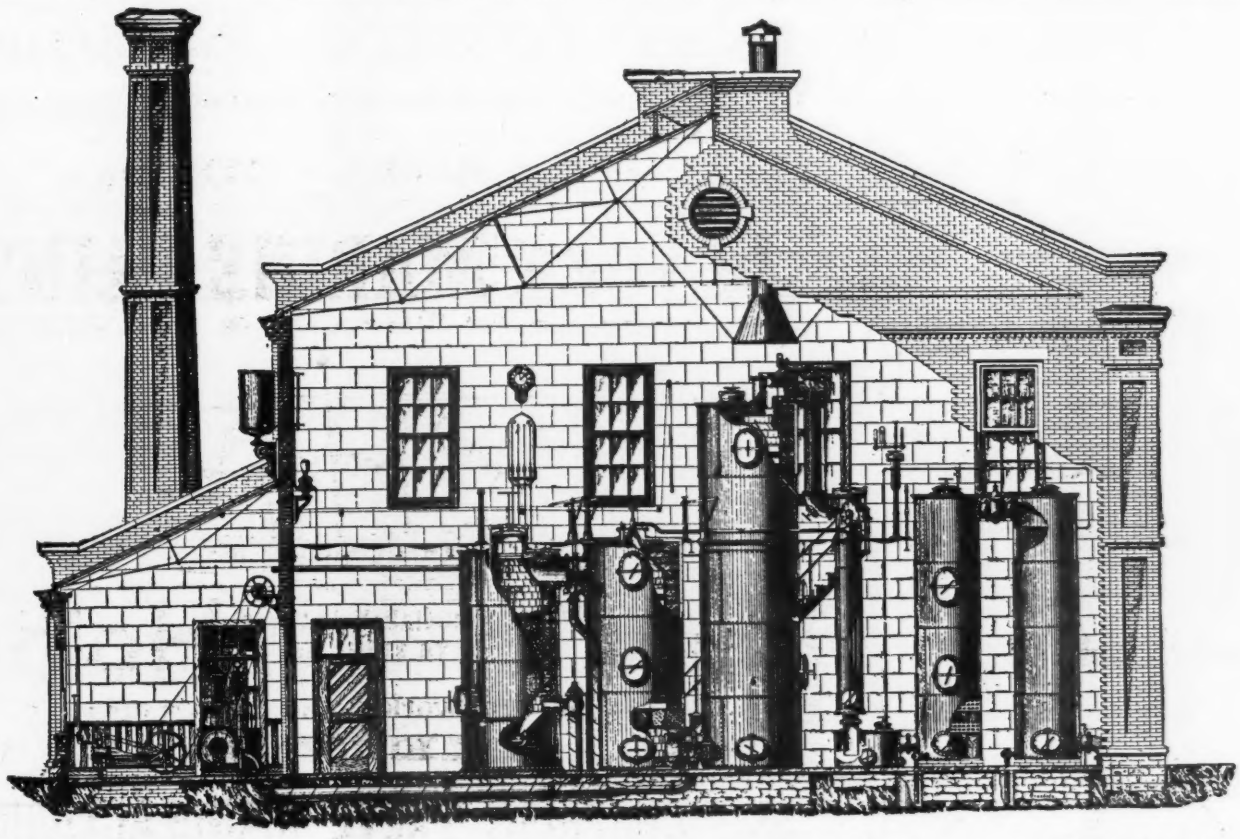

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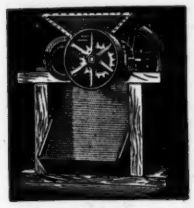

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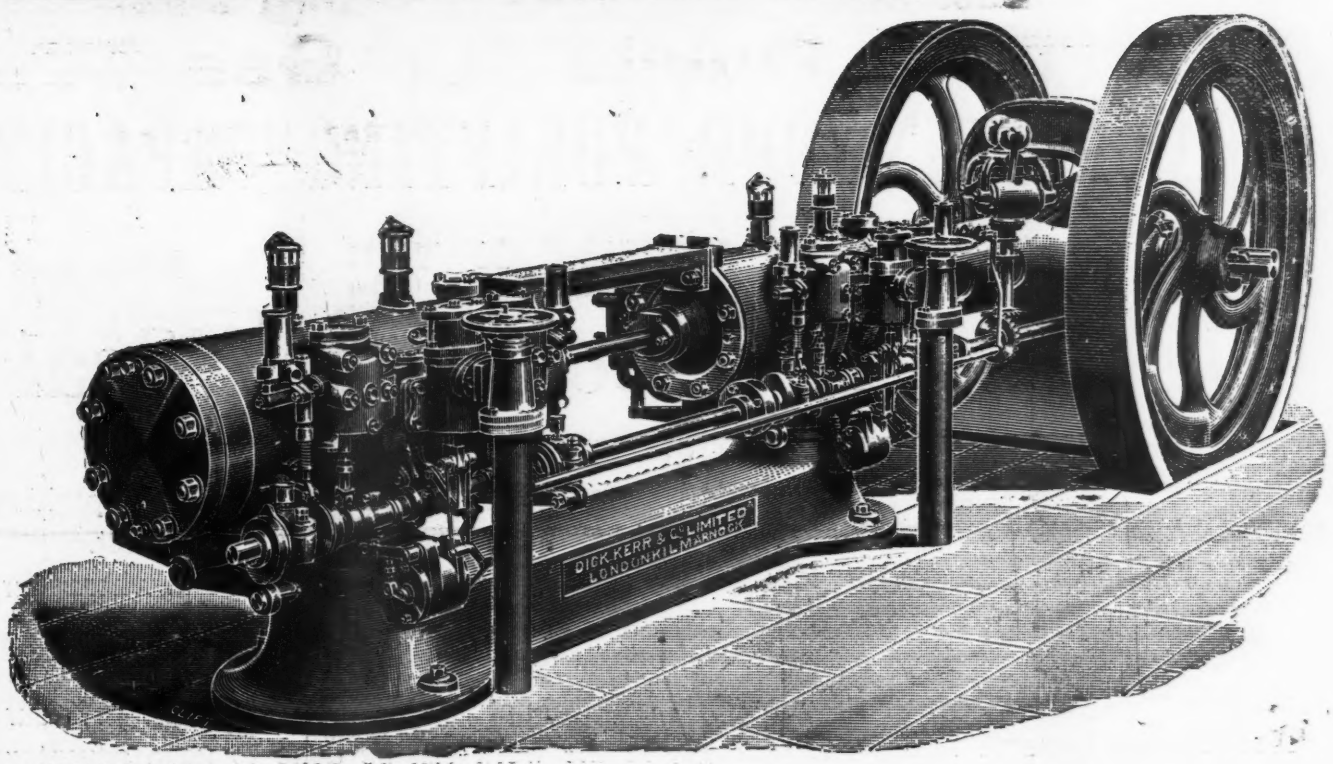

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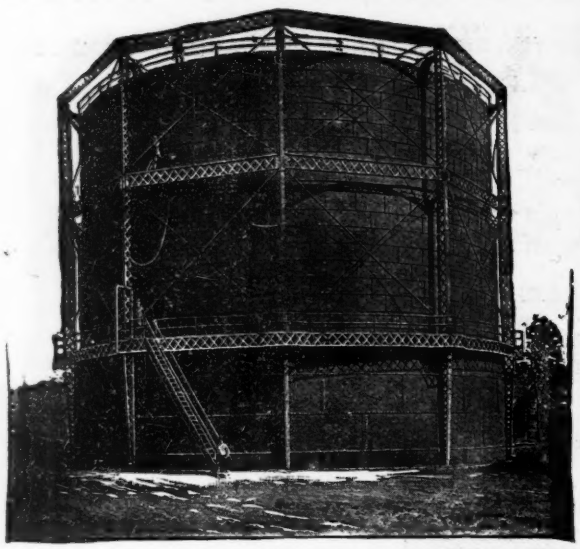

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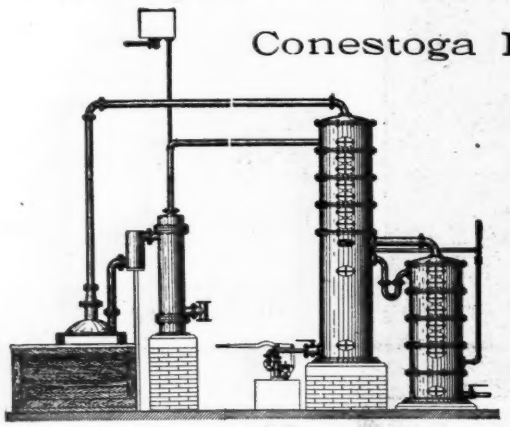

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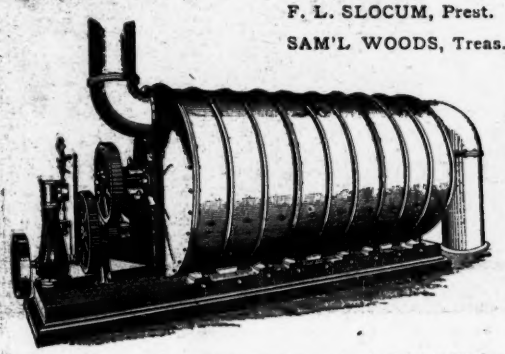

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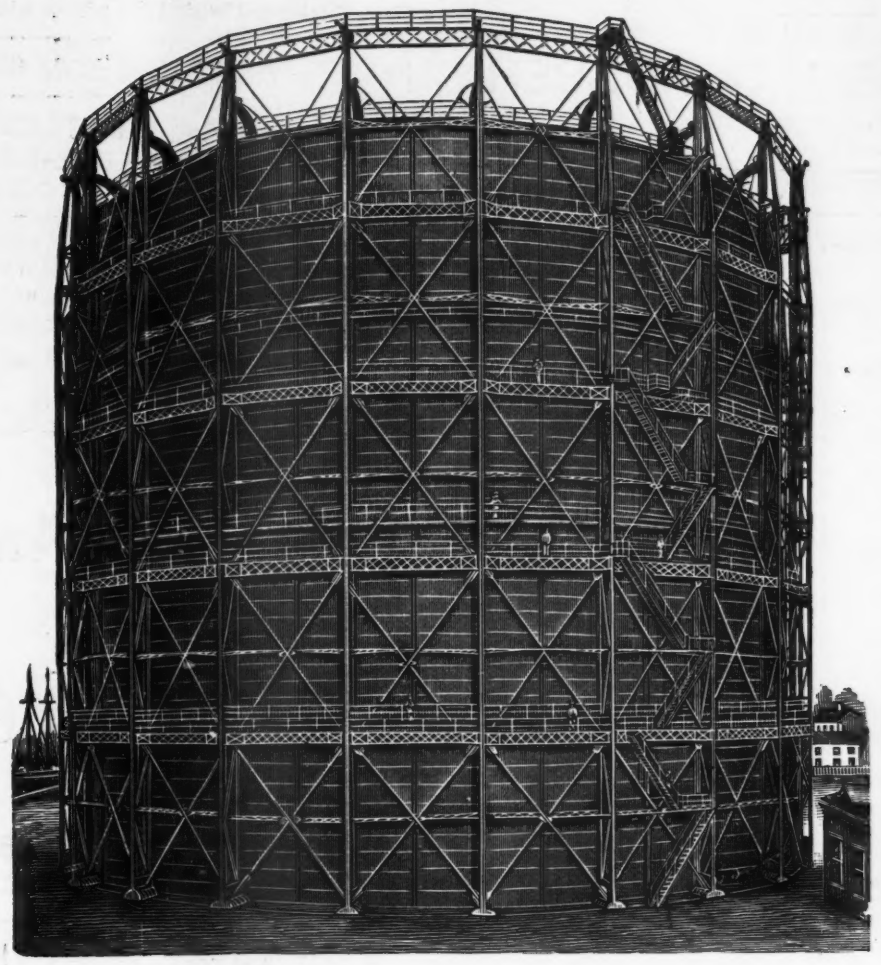

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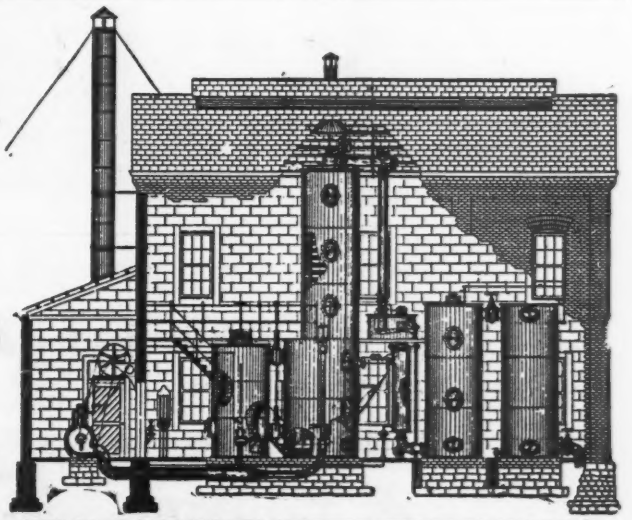

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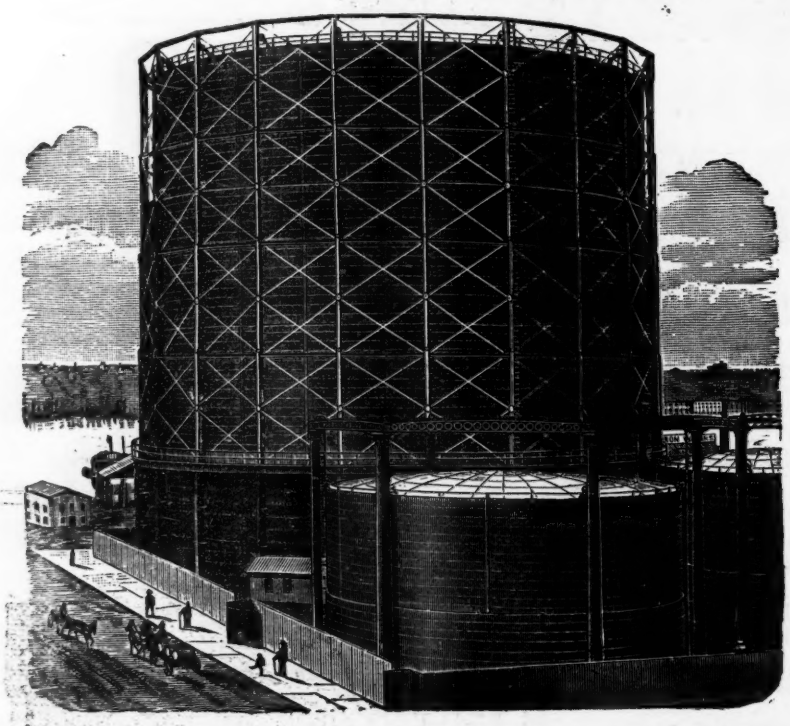

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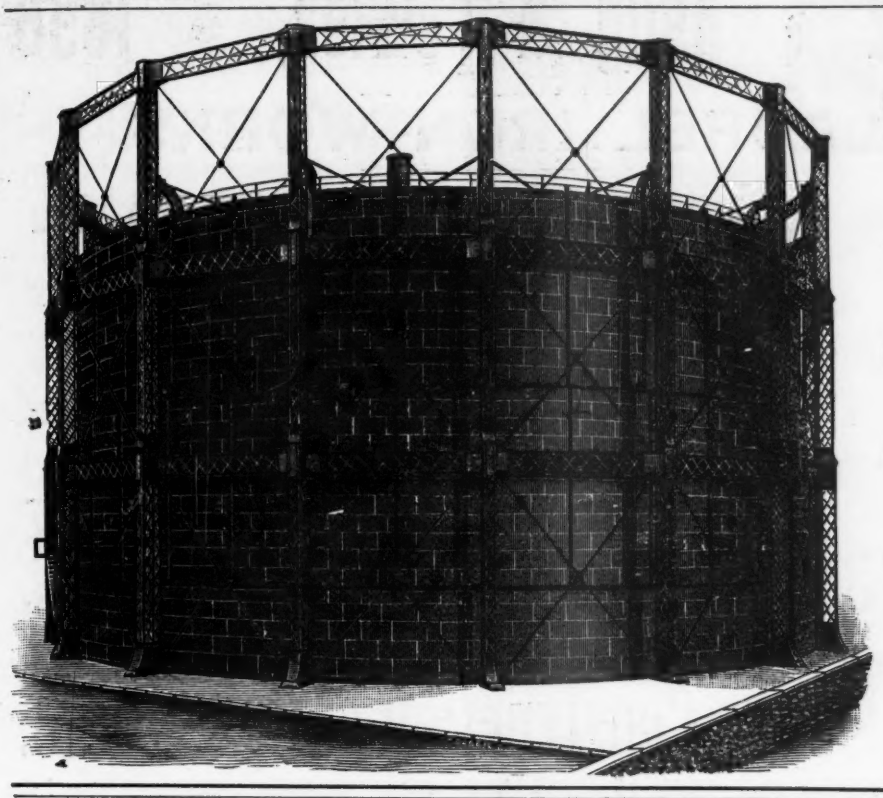

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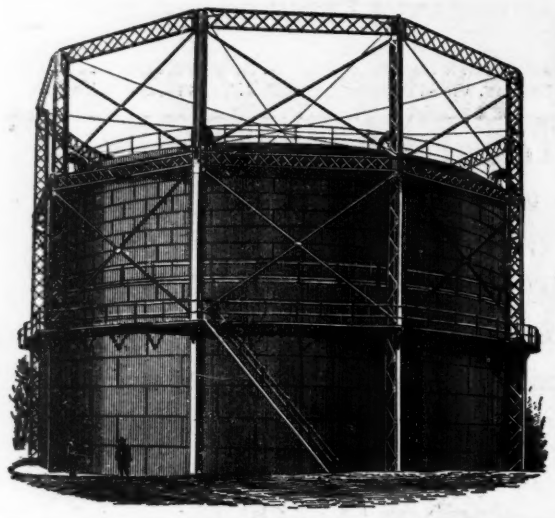

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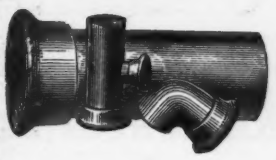

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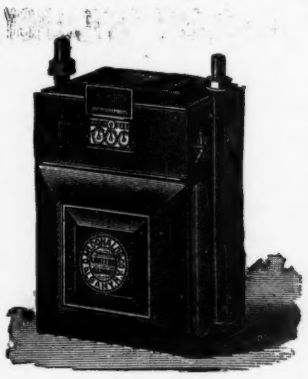

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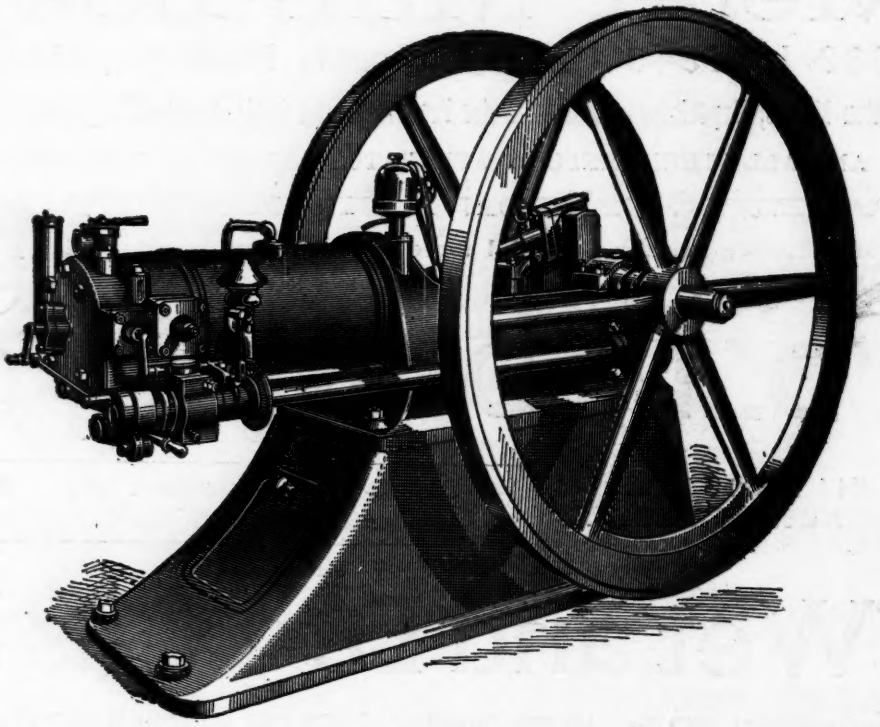

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